ACORN USER

Number 2 September 1982 £1

Atom in action
Art on the screen
Make some music
Bugged by the ULA
The BBC in business
Teletext saves memory
How good is the Beeb?

Acorn User

The official magazine for users of the Acorn Atom, the BBC microcomputer system, and the Econet system, published by Addison-Wesley for Acorn Computers Limited.

- Authoritative information on all new Acorn products
- All the latest software reviewed, including the products of Acornsoft
- New peripheral equipment described and tested, including unofficial items
- Feature articles on the latest developments in microcomputing from the UK, Europe, North America the Far East, and Australasia
- Dealer and service features
- National and international user group news

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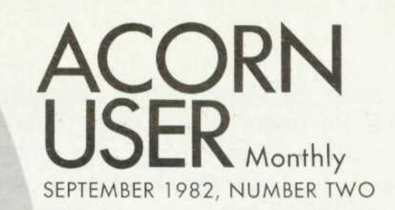
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Front cover: Brian Reffin Smith produced this piece of art using the drawing package Jackson, at the Royal College of Art in London (see article page 27).



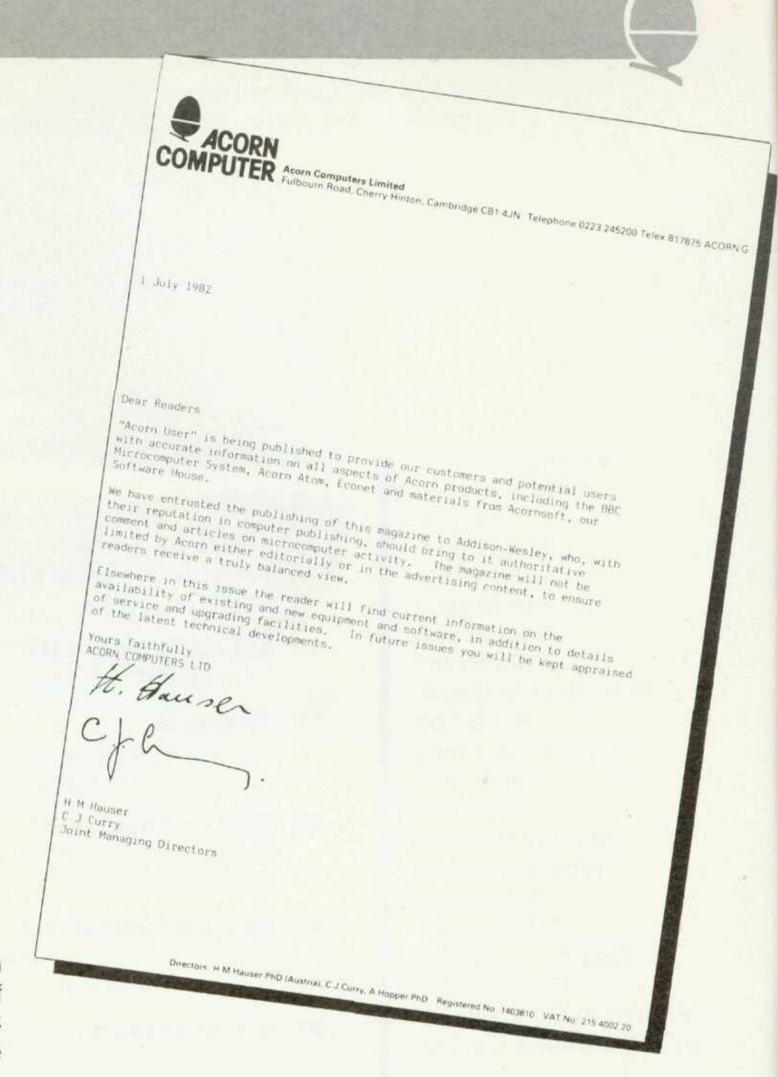
How to submit articles
You are welcome to submit articles to the Editor of *Acorn User* for publication. *Acorn User* cannot undertake to return them unless a stamped addressed envelope is enclosed. Articles should be typed or computer written. Black and white photographs or transparencies are also appreciated. If submitting programs please send a cassette or disc. Listings should not contain more than 39 characters per line for ease of reproduction. Payment is £50 per page or pro rata. Please indicate if you have submitted your article elsewhere.

Send articles reviews, and information to:
The Editor, *Acorn User*, 53 Bedford Square, London WC1 3DZ

See next month's *Acorn User* for:
● Communication by micro across the world ● Red/green/blue decoder for the Atom ● Speech from the Beeb ● Tips on the pitch envelope and moving graphics ● BBC paddles ● Printing graphics ● Book reviews ● Computer crime

EDITORIAL

In the second issue of Acorn User, the official, **monthly** magazine for users of Acorn products, we bring you more authoritative, official and accurate information. We include items for potential business users, musicians and code breakers – to name but a few. Whatever your interests we cater for them.



ACORN COMPUTER Acorn Computers Limited
Fulbourn Road, Cherry Hinton, Cambridge CB1 4JN Telephone 0223 245200 Telex 817875 ACORN G

1 July 1982

Dear Readers

"Acorn User" is being published to provide our customers and potential users with accurate information on all aspects of Acorn products, including the BBC Microcomputer System, Acorn Atom, Econet and materials from Acornsoft, our Software House.

We have entrusted the publishing of this magazine to Addison-Wesley, who, with their reputation in computer publishing, should bring to it authoritative comment and articles on microcomputer activity. The magazine will not be limited by Acorn either editorially or in the advertising content, to ensure readers receive a truly balanced view.

Elsewhere in this issue the reader will find current information on the availability of existing and new equipment and software, in addition to details of service and upgrading facilities. In future issues you will be kept appraised of the latest technical developments.

Yours faithfully
ACORN COMPUTERS LTD

H. Hauser
C J Curry

H M Hauser
C J Curry
Joint Managing Directors

Directors: H M Hauser PhD (Austria), C J Curry, A Hopper PhD Registered No 1403810 VAT No: 215 4002 20

Independent hardware reviews

We publish an independent review of the BBC micro and the Spectrum. We felt this would be of interest to readers as so many extravagant claims have been made about the Spectrum. In our view, the BBC micro is a much more powerful machine and is a wiser buy for anyone with a serious interest in microcomputers.

Readers' letters

Letters and telephone calls have poured in from readers all over the world. We like to hear from you, but bear with us if you have not yet received a reply. Keep on sending your queries, comments, hints and tips or complaints. A selection of letters will be published every month.

Atom users

We have been inundated with complaints from Atom buffs that they were neglected in the first issue of **Acorn User.** Greater emphasis was given to the BBC micro but given the topicality of the machine at the time and the number of unresolved issues, I think we can be forgiven because the Atom is a well established micro. We have included more on the Atom in this issue and will continue to do so. We would particularly welcome contributions from Atom enthusiasts for consideration for publication.

BBC

The BBC will be making regular contributions, and this month we have articles from John Radcliffe, David Allen and Meyer Solomon of the Computer Literacy Project. See page 10 for details of the BBC's telesoftware plans. We also have news from BBC Publications about their software.

Acorn User competition

Entries to our first competition have come flooding in. Look out for the results in the October issue of **Acorn User**. This month's competition is on page 56.

PCW Show

We will make our presence felt at the Personal Computer World Show at the Barbican Centre in London, September 9-12. You'll find us on stand 444 in Hall B (upper). Acorn Computers will be there and there will be a separate dealer arcade (page 8). See you there!

Official dealers

For those needing servicing and upgrading facilities, we would advise you to consult the official dealers list on page 62. Each month we wil carry an update.

Software and books

You are invited to submit your programs and books for review. Future issues will carry substantial coverage of all products related to Acorn computers.

User groups

Each month we will list user groups which have come to our notice (page 58). If you are running a group let us know.

Contributors

If you have any articles, hints or programs – we're ready and waiting! Articles should be typed or computer written, with black and white photographs, or colour transparencies. When submitting programs please send a cassette or disc with a full printed listing.

Jane Ransella

Managing Editor



Hauser hits at Sinclair campaign

ACORN director Hermann Hauser has attacked Sinclair's comparison advertising campaign in the computer press.

Hauser described the six page insert as 'unfair and incorrect' and said he was considering taking the matter up with the Advertising Standards Authority – who have already had several complaints about other Sinclair promotions.

The main query was Sinclair's claim: 'What may not be so obvious is that it also provides more power.' This claim is made in direct comparison to the BBC model A.

Hauser's reply was: 'Whichever way you measure it the BBC computer is more powerful than the ZX Spectrum.

'The first measure of power is benchmarks – and the BBC model A is three to five times faster than the Spectrum.'

The benchmarks are widely used in the computer industry and quoted in magazines.

Another incorrect assertion was that the maximum RAM for the BBC *model A micro* was 32k.

In fact it can go up to 96k when a second processor is added, said Hauser.

He added that the model A could give eight colours, that the display ran up to 32 not 25 columns, and that it did provide VERIFY and MERGE statements, but under a different name.

The advertisement also gave the impression that the model did not provide user-definable graphics.

And close analysis of the insert shows that it has had several alterations.

The insert marked 'PCW807' had no less than eight changes compared to that marked 'COT806'.

However, Sinclair's advertising agency Primary Contact defended the insert. Spokesman Chris Fawkes said: 'The information has been correct as far as we can check. It was provided by our client Sinclair.'

He admitted receiving a complaint about the insert from the ASA, to which he had replied. Changes had been made since it came out in June and a third version produced.

On the subject of power, he said it was a difficult comparison to make and that bench tests were the most independent assessments. But, he added, Sinclair had clarified his claim by referring to the RAM provided.

How the ZX Spectrum compares with other personal computers.

	ZX Spectrum	BBC micro model A	VIC 20	ATARI 400	TI 99/4A	TRS 80 Colour
Guide price – basic unit inc. VAT	£125	£300	£190	£300	£300	£450
Standard RAM	16K	16K	5K	16K	16K	16K
Standard RAM available using high-resolution graphics	9K	3K	N/A	7K	14K*	10K
Maximum RAM	48K	32K	29K	32K	48K	32K
Sound generator	✓	✓	✓	✓	✓	✓
Colours available	8	8	16	16	16	9
Maximum colours on screen at one time	8	4	16	5	16	8
FLASH	✓	✓				
BRIGHT – or equivalent	✓			✓		
High-resolution graphics (>40000 pixels) available for PLOT & DRAW	✓	✓		✓		✓
User-definable graphics characters	✓				✓	
Full upper/lower case ASCII	✓	✓		✓		✓
User-definable character set	✓	✓	✓	✓	✓	
Screen display (columns x rows)	32 x 24	40 x 25	22 x 23	40 x 24	32 x 24	32 x 16
Auto-repeat on all keys	✓	✓		✓	✓	
Cassette interface for all normal recorders	✓	✓			✓	✓
Baud (data transfer) rate	1500	1200	300	1200	450	1200
LOAD & SAVE	✓	✓	✓	✓	✓	✓
VERIFY	✓	✓	✓		✓	
MERGE	✓			✓		

*But PLOT & DRAW not available

Elegant, effective, unique – the ZX Spectrum design.

'Less than half the price of its nearest competitor – and more powerful.

'These two pictures show how it's done. On the right is the PCB from the BBC Model A Microcomputer. On the left is the PCB from the ZX Spectrum.

'It's obvious at a glance that the design of the Spectrum is more elegant. What may not be so obvious is that it also provides more power.

'The ZX Spectrum has more usable RAM, and higher maximum RAM.

'It offers twice as many colours on the screen at any one time, plus a colour brightness control. It also offers user-definable graphics.

'It has data transfer rate 25% faster, supported by a VERIFY facility.

'And it employs a dialect of BASIC (Sinclair BASIC) already in use in over 400,000 computers worldwide.

'We believe the BBC make the world's best TV programmes – and that Sinclair make the world's best computers!'

– *Clive Sinclair.*

The offending table from a recent computer magazine – contains eight changes

Acorn drops hints on Electron

The Electron will be in the price range of the Spectrum, but out perform the Apple – that's the confident prediction from Acorn.

The company is unwilling to release any specification or photographs of their new machine as they feel it would spoil the launch. Their spokesmen are talking in terms of a December release – but even that is not definite.

Acorn have, however, let lip that they are working on prototypes of a full facility 3½" micro-floppy for their computers. And they forecast a price tag of under £100.

And prototype microfloppy 'for £100' on test

This compares with Sinclair's much vaunted –but not yet seen – Microdrive which is advertised as 'available later this year, for around £50.'

However, several 'Sinclair-watchers' have said this is unlikely to be a proper microdrive as it may not have a random access facility and will be more like a fast cassette, without the full advantages of a floppy disc.

Nobody is giving anything away at Acorn on test results, or a release date –but we'll let you know.



Weetabix troubleshooters aid distribution handover

THE BBC's new distribution system for its micros was due to be in action from today.

Vector marketing, an Acorn subsidiary, has taken over from BL Marketing at Kettering.

John Radcliffe, executive producer of the BBC Computer Literacy Project said there had been 'a few teething problems', but that these were being dealt with.

The change, said Mr Radcliffe, was because of 'a very heavy volume of calls and letters which strained the BLM system beyond its capacities'.

He hoped the new distribution organisation with its computer record system would provide a good service for the 'disgruntled users – or would-be users' of BBC micros.

Vector have installed a computer to deal with the operation and plan to use BBC micros as terminals with purpose-written software.

Weetabix – BLM's parent company – appointed a 'trouble shooting' team to ensure the handover to Vector was as gremlin-free as possible.

Customers with outstanding orders for micros and peripherals should have received a letter giving a new order number. Please quote this with any enquiries.

Vector spokesman, Peter Goater, said the new Alpha computer was working 'very well indeed', but added that delivery delays couldn't be solved until the production backlog was filled.

The new address will be Vector Marketing, Denington Industrial Estate, Wellingborough, Northants, NN8 2RL. Tel: Wellingborough (0933) 79300

Maths, science English and Lisp programs

EDUCATION programs on simple science, maths and English are now available on cassette and disc for the BBC micro.

The science programs cover speed, time and distance; properties of light; electric current theory and Archimedes' principle. Maths theory covered is addition, subtraction and division, while the language program tackles sentence construction, word sequencing and spelling.

All three are produced by Acornsoft, with prices starting from £8.65 per cassette and £13.65 per disc.

The list processing language Lisp has been adapted for the Atom and the Beeb.

Acornsoft and Owl Computers developed the interpreter which is provided on cassette at £17.25 for the Atom, and £16.85 for the Beeb, both including VAT. The books – Lisp Theory and Practice (£6) and Lisp on the BBC Microcomputer (£7.50) – were written as introductions.

Cassettes and books are available through dealers, or from Acornsoft direct at 4a Market Hill, Cambridge CB2 3NJ.



Any help for Denis?

DENIS Thatcher and his two friends look a bit non-plussed by whatever their BBC micro is up to. The students are from South Downs College near Havant where the Prime Minister announced the Government's £9m subsidy for micros in primary schools. The date for Mrs Thatcher's brave new world, when all primary and secondary schools will have micros is 1984. Perhaps it was that ominous date which was worrying our intrepid trio. **(Turn to page 54 for a picture of the PM in action.)**

Dealer tests

TEST equipment for the BBC machines is now in production, says Acorn.

The final inspection tester (FIT) and the progressive establishment tester (PET) will both be offered to dealers at £80 and £200 respectively.

Learning with simple listings

TEN programs to help you explore the potential of the BBC micro are contained in *Learning with the Beeb*, by Eric Deeson. It is aimed specifically at educational users and produced by AVC Software, who have up to now sold software for the Sinclair range.

The longest listing is 46 lines and the level of program varies from primary/remedial to 16-plus physics, although most can be played by children of any age. Games include a reflex tester, train race, bar chart, graph, projectile simulation – and even a simple version of Logo.

The booklet costs £2.50 in the UK, and is 50p dearer elsewhere. Members of Muse, Beebug and Ezug can buy it for £2.

Details from AVC Software, PO Box 415, Harborne, Birmingham B17 9TT.



£9m primary school micro subsidy set to go

THE Government's £9m scheme to provide microcomputers in every primary school by 1984 will start from next month.

Primary spending on any of three chosen systems will be matched by the Department of Industry. The price to schools includes a cassette recorder training material, monochrome TV with the option of a colour monitor.

Two of the packages are similar to those offered to secondary schools – the BBC Acorn Model B £540, (colour monitor £110 extra) and the Research Machines Link 480Z (£818 plus £104). The third system is the Sinclair Spectrum at £346 (plus £126).

This scheme is an extension of the secondary scheme, started last April, and the Government believes it is 'well on target' in its aim of seeing a micro in every secondary school. So far, 5200 have been provided between the 6000 schools – although the Department of Industry believes every secondary school now has at least one micro. Application should be made through local education authorities, who have been provided with details for the school year's start.



John Radcliffe of the BBC

Telesoft receiver details

PRODUCTION of the telesoftware receiver is due to start next month at Acorn in Cambridge.

The BBC estimates it has received 1200 orders for receivers, and is hoping for 5000 within the next year. And the Corporation is already transmitting a telesoftware magazine REM on page 705 of Ceefax.

The 'magazine' is nine pages long and gives news *about* the BBC micro. It is updated every two weeks, (see page 10 *Acorn User*).

Teletext is called using the command *TELETEXT, and channels can be switched by typing *BBC1, *BBC2 or *ITV.

The display will be 25 lines high, leaving the bottom line free for message or commands to be typed in.

Software for transmission has been written by the Government's Microelectronics Education Programme, Acornsoft and the BBC.

John Radcliffe, executive producer of the BBC Computer Literary Project, sees a great future for telesoftware.

The only problem, he said, was finding some way of funding it as in its present form it is free to users. And the BBC cannot, of course, carry advertising on the service.

For more news, see pages 10 and 11.

Second TV series

THE BBC has announced the dates for transmission of their second computer series – *Make the Most of Your Micro.*

The ten programmes are scheduled to start on BBC 1 on Sunday January 9 and will run until March 13. The broadcast time will be 12.35 to 1.00 pm, with repeats on Mondays from 3.05 to 3.30 pm. The series will again be shown late at night on Mondays in May.

Meanwhile, the first series will be repeated on BBC 1, Sundays 12.35 to 1.00 pm from October 10 to December 12; again on Mondays 3.05 to 3.30 pm on BBC 2 from October 11 to December 13.

Another series *Micros in Education* will be broadcast on Monday afternoons 3.30 to 3.55 pm on BBC 2 from February 13 to March 14 and repeated on Sunday mornings BBC 1 in May.

BBC software review to start

Acorn User is to begin a major software review section. All programs for BBC micros – A and B – will be studied and assessed by an independent panel of experts.

No matter how small or large your programs are, whether you write them at weekends or for the BBC, if they are sold we will review them.

The software can be directed at any market – games, educational, business, word processing. Please include standard packaging and instructions with tapes, as well as price list.

Send your cassettes or discs to Software Review Editor, Acorn User, 53 Bedford Square, London WC1B 3DZ.

The sooner we receive your contribution, the sooner we can review it and assess it for our readers.



Cassette lead

THE diagrams on wiring up the BBC micro cassette interface on page 14 of July's *Acorn User* are correct. However, one part looks *into* the wire while the other part looks *out*. So follow the numbers, then you can't go wrong. Pin numbers are stamped on the insulation of the DIN plug.

New Guides

REVISED *User Guides* are now being delivered and everyone should have them within the next week, says the BBC. Over 9,000 were despatched in the first week of August, and the BBC had taken delivery of almost all copies. The delay in sending them out was apparently caused by difficulties with ring binding.

BBC soft

AUNTIE has jumped into the software market with eight cassettes for the BBC micros. They cover home finance, early learning, games of strategy, fun games, painting, drawing, music and programs from the *Computer Programme.* Each costs £10 from BBC Publications.

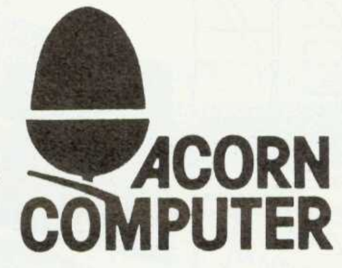
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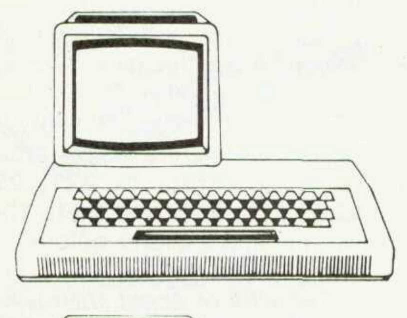
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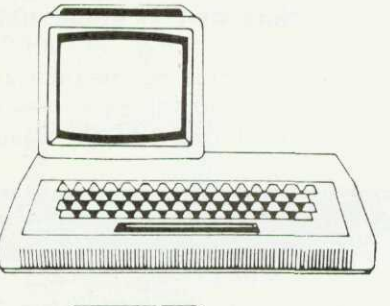


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my Access No. ____

Signature ____

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Telephone ____



IT'S ALL THERE



Acorn put on fun and games for every user

Acorn are exhibiting on two stands at the PCW Show in London's Barbican Centre on September 9-12.

Stand 200 is for hobbyists in the **upper hall A** and features a host of computers for keenies to play with. An Econet will be on display with the new System 5s as file servers. If you've never heard of Smartarm, now's your chance – they're robotic arms produced by Systems Control Ltd and worked by Atoms.

And if you want to see a laser, Acorn have Laserpoint – where the beam is controlled by an Atom.

The **lower hall B** holds Acorn's exhibit for educational and business users on stands **317 and 322**. Dedicated BBC machines will demonstrate word processing, ULA chip design and circuit board drawing.

Again you will be able to get your hands on the keyboards to test out software for schools and the office.

An interesting application on view is a spectrometer used to diagnose certain cancers, with the help of Acorn micros.

The upper and lower stands will never be far away – they're connected by Econet.

And last – but certainly not least – there's the Acorn Arcade in hall A on stands **221, 223, 225, 227, 229 and 331.** There will be applications galore – all using Atoms and Beebs.

The staff of *Acorn User* will be on **stand 444** in **upper hall B** under the wing of Addison Wesley Computing, the publishers. Also featured will be books and software for schools and colleges.

EXTRAS IN THE ARCADE

Computer Concepts specialise in software for the BBC micros (we deal with no other machine) and will be demonstrating the Wordwise word processor. This ROM-based text editor and formatter written specifically for this computer is a sophisticated piece of software.

We will also have a large range of cassette-based software on sale including games such as Snake, Fruit Machine, Cube, etc., and utility programs as well as Basic Logo.

Electronequip specialise in software and services for Acorn products. A full repair service (including warranty) is available, as well as support for customer modifications. For details phone (0705) 325354.

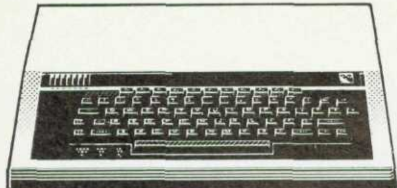
Eltec Services of Bradford are dealers for Acorn products, including the BBC micro and the ACT Sirius 1. See Eltec Services in the Acorn Arcade at the PCW show and receive extra help and attention and see some exciting products. Or contact them on Bradford (0274 491372).

Silversoft will be demonstrating and selling their range of cassette-based BBC microcomputer software. Prices range from £5.95 and all the cassettes come with detailed instructions.

Microage Electronics will be demonstrating and selling a complete range of Atom and BBC compatible disc drives, printers, cassette recorders, monitors, paper and software. Microage from London are promising some bargains on their two stands.

Mutek on stand A8 will have for sale: Voxbox (speech synthesiser); Spriinter (see GB Computers on stand A11) and will be demonstrating their range of add-ons for the BBC – and other micros. Details from Mutek (MSF) Ltd., Tel: (0225) 743289.

GB Computer Products will be on stand A11 showing how Mutek's Spriinter stores print data in its own memory, thus freeing the computer for other tasks. The machine will be on sale. Details from GB Computer Products, 14 Greenwood Grove, Winnersh, Wokingham RG11 51H. Tel: (0734) 786635/791678.



BBC Microcomputer

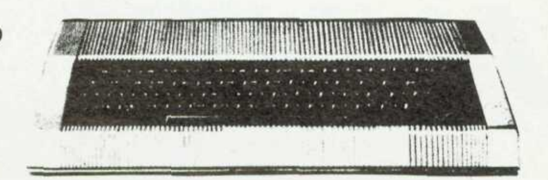
BBC Model A **£299**
Model B **£399** (Inc. VAT)
(Carr. £8/unit)
Model A to Model B Upgrade Kit **£60**
Memory Pack 8X84816AP **£21.60**

Print & User Parts Kit **£9.50**
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RS423 & VDU Parts Kit **£10.80**
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(the above prices do not include fitting charges)
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Full range of ACORNSOFT, BUGBYTE & PROGRAM POWER software always in stock
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Expanded 12K + 12K **£175** 8K + 5K + Colour Card **£169**
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All ATOM Buffers & Connectors in stock
Atom Forth **£10** Atom Lisp **£15** Atom Calc **£34**
Monitor ROM for direct entry of Machine Code **£16**
Atom Disc Pack **£299** + £7 Carr.



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HERE COMES AUNTIE



by **DAVID ALLEN**

An exciting new use for the broadcasting television signal is the transmission of programs on Ceefax which can be received by a decoder and immediately 'run' at home on a BBC micro. Telesoftware could provide broadcasters with the chance to provide viewers with interactive material to back up a television series.

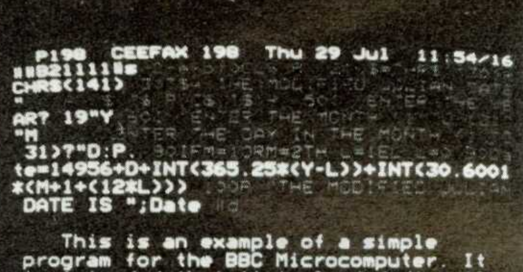
A computer program – if it works and satisfies editorial and technical criteria – can be run into the Ceefax computer at Television Centre to appear as a series of cycling subpages on an allocated page of the Ceefax magazine. You can see an example of telesoftware on pages 703 and 704 of BBC1 Ceefax. Hence, a computer program can be broadcast to the user at home instead of having to be typed in by him or run in from tape.

A domestic decoder has been developed by Acorn Computers, working with BBC design and research departments. If this decoder is connected to the television aerial and to the BBC micro then, if the television signal is good, it can detect the page of Ceefax carrying telesoftware and download it into the computer's memory. It is exactly as if the owner had typed it in on the computer's keyboard himself.

Because of the relatively high cost of producing programs, telesoftware would (initially at any rate), be likely to come from public sources – such as Department of Education's Microelectronics Education Programme, which is commissioning software for use in schools. Alternatively, some material might consist of modified programs designed to encourage subsequent sales.

Given sufficient resources, there are many possibilities, ranging from 'game of the week' and quizzes to the transmission of political or economic data to be processed by home computers.

Finally, there is the idea of a club page, where viewers' programs can be put on the air. Editorial



```
 P198  CEEFAX 198  Thu 29 Jul  11:54/16
CHR$(141)
AR? 19"Y
"M
 31)?"D:P.
te=14956+D+INT(365.25*(Y-L))+INT(30.6001
*(M+1+(12*L)))
 DATE IS ";Date

    This is an example of a simple
program for the BBC Microcomputer. It
is intended that it is loaded directly
into a computer fitted with a teletext
adaptor, which is why it is difficult
to read. Another version of the same
program follows which can be copied
down by a programmer or read by the
machine.
    This method of distributing computer
programs is called TELE

            Another Exam
```

```
 P198  CEEFAX 198  Thu 29 Jul  11:53/49

 10 CLS   PRINT
 20 C$=CHR$(130)+CHR$(141)
 30 T$="THE MODIFIED JULIAN DATE"
 40 PRINT C$,T$   PRINT C$,T$   PRINT
 50 INPUT "ENTER THE YEAR? 19" Y
 60 INPUT "ENTER THE MONTH (1 to 12)?"M
 70 INPUT "ENTER THE DAY IN THE MONTH (1
      TO 31)?" D   PRINT
 80 IF M=1 OR M=2 THEN L=1 ELSE L=0
 90 Date=14956+D+INT(365 25*(Y-L))+INT(
      30 6001*(M+1+(12*L)))
100 PRINT "THE MODIFIED JULIAN DATE IS
      ,Date

xample of a simple
 BBC microcomputer.It
ed automatically if the
uitable adaptor or can
ectly.

er Example follows
```

```
 P198  CEEFAX 198  Thu 29 Jul  11:55/45
BBC TELESOFTWARE  10 REM LANDER
 - a lunar lander game  11 REM (c) BB
C 1982  12 REM by Jim Murray  13
REM Version 1.1 / March 1982  14 REM
needs 32K BBC Microcomputer  20 ON ER
ROR REPORT:GOTO 320  30 MODE 7  50
 PROCintro  60 MODE 5  70 VDU 23,2
40,8,8,28,28,62,62,62,62  80 VDU 23,2
41,62,62,62,62,62,62,62,62  90 VDU 23
,242,62,62,62,127,127,127,93,93  100 V
DU 23,243,28,60,30,60,126,108,162,162
 110 VDU 23;8202;0;0;0;  120 VDU 19,2,
2,0,0,0  130 VDU 28,0,19,11,1  140 @
%=&000906  150 *FX 11 1  160 PROClab
els  170 PROCmoon  180 PROCinitialis
e  190 VDU 5  200 X%=960  210 GCOL
 0,3  220 REPEAT  230 burn$=INKEY$(0
)  240 *FX 15 1  250 IF burn$="" THE
N burnrate%=0 ELSE burnrate%=VAL(burn$)*
30  260 PROCcalculate  270 PROCdashb
oard  280 IF Y%>oldY%+4 OR Y%<oldY%-4
THEN PROCrocket  290 PROCburn  300 U
NTIL height=0  310 IF speed>flop THE
```

Shape of things to come. . . these three pictures are all taken from the Ceefax service, showing just what the BBC is up to



Telesoftware is on the way, and judging by these pictures coming over the airwaves from the Ceefax stable, Auntie is pretty near to sorting things out at her end. Present transmissions – like the Channel 4 testcards – are only experimental, with engineers downloading programs to test Acorn-built telesoftware receivers. Anyone with a Ceefax set can pick up these pictures, but the receivers to download software directly into BBC micros are not yet available.

The REM newsletter page is coming over Ceefax to let people know just what is happening and provide some simple programs. We hear that there will be programs to interest every sort of user – games, educational, business and household. The programs are in BASIC but have special symbols which are decoded by the BBC teletext unit (see the letter on page 60).

responsibility for telesoftware will lie with the editor of Ceefax.

Test transmissions are already on the air and decoders should soon be available. They will *not* require the use of teletext television set and, indeed, will enable those who own model B micros to receive standard teletext transmissions from the IBA and BBC as well as telesoftware. The only thing which may not be possible is the mixed picture and text facility used to give subtitles for the deaf. However, the decoder will enable certain other features of teletext to be used, such as the storage of 'linked' pages. This will mean that the viewer will not have to wait for these pages to cycle round – they will have been captured automatically by the computer's memory

Telesoftware is the first chance to provide interactive material as part of the television signal. It is too early to tell how the service will proceed, but interest has been considerable.

David Allen is producer of the Computer Programme and editor of the Computer Literacy Project

Guide in a nutshell

The revised *User Guide* contains many tips on good programming scattered throughout so here, I have gathered a few together.

Use as few GOTOs (and, in general, GOSUBs) as possible, instead, use procedures and functions at the end of the program. Try to declare LOCAL variables in procedures. Never define procedures and functions within the body of a program. But GOTOs are useful for handling errors. When developing programs, redefine one of the function keys to give mode 7 and then LIST.

Don't waste precious time trying to memorise VDU codes and *FX. Remember, the VDU statement is generally preferable when sending characters to the screen.

CALL transfers control to a machine code subroutine. Use it within a Basic program only if you have a thorough grasp of assembly language, otherwise you may mess up your program. The CHAIN statements come in handy if you are writing a game with a lot of instructions.

The 'resident integer variables' @% and A% to Z% help you retain values that would otherwise disappear after CLEAR, NEW and LOAD.

When using the INPUT statement, print a message on the screen to tell the user what response is expected. A good way of suppressing the ? mark is by having "" just before the input (X, or whatever) you expect from the user. Use the ESCAPE key for stopping a program; avoid using BREAK.

It is bad practice to jump out of a REPEAT --UNTIL loop with a GOTO statement. If you do jump out, jump back in. Always exit a subroutine with a RETURN. Avoid leaving it with a GOTO.

These are just a few points, and the best exercise you can do is to make notes of all the advice you come across.

Meyer Solomon
Software Editor
BBC Publications

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BUSI-BEEB

The BBC micro is too new for many uses, but it has potential says John Turnbull



The BBC micro for business computing – is it on? This is the question asked by many who have ordered a system and by many others who are wondering whether to take the plunge.

What must be made clear straight away is that the present system is not suitable for serious business applications – as indeed is the case with any cassette-backed system lacking application programs. Any business user who identifies a need for a computer will require disc drives, printer and suitable programs.

But that's not the end of the story, as many purchasers of systems are exploring computing in anticipation of viable systems. For some this will mean rejecting the BBC system in favour of others which offer specific application packages. But for others, the growth of facilities will be more than adequate and, assuming programs emerge, their organisations will build around this flexible system.

First though, you've got a machine and, assuming you can get near it, let's see if it can be used now to help the business.

For a start, here's a program which does no more than add up numbers – like a calculator but without the frustration.It simply uses the fact that the computer display contains much more information than a calculator display.

```
10 PRINT "Enter numbers to be
   added"
20 PRINT"To finish, enter a zero"
30 T=O
40 REPEAT
50 INPUT X
60 T=T+X
70 UNTIL X= O
80 PRINT T
```



Now that's a bit crude and you don't need to know much about programming to improve on it. One less obvious technique would be to suppress the line feed after INPUT and thus provide much more information on the screen. To do this, control the INPUT with a TAB function. Omitting the original instructions, the above program could become:

```
30 CLS: T=O:P=O
40 REPEAT
45 C = 10 * (P MOD 4) : R = 6 +
INT (P/4)
50 INPUT TAB(C,R) X
60 T=T+X : P=P+1
70 UNTIL X=O
80 PRINT : PRINT "total" T
```

(Note: the INPUT position is defined by row R and column C)

Even this little program can reduce significantly the time spent preparing VAT returns. Another program aids stock valuation where stock had been purchased (and prices quoted) in varying quantities. Fundamental stages in the program were:

```
INPUT "NUMBER IN STOCK" N
INPUT "PURCHASING QUANTITY"
Q
INPUT "COST PER QUANTITY" C
TOTAL = TOTAL + N * C/Q
```

The opportunity to develop and use simple models such as these will grow considerably as financial modelling packages appear.

First priority will be twin floppy disc drives. As with any system, two drives are suggested to provide security copies. For the new user of computers it is essential to retain back-up copies of essential files and institute a system of archiving.

An alternative to floppy disc storage is the Winchester disc which is attractive in terms of speed, reliability and capacity.

For applications in which the output stays in house, a cheap dot matrix printer will suffice. However, if documents are to be sent out a letter quality printer is essential.

As for software the small business may require packages specific to the trade or may be looking at standard applications. Production of such packages takes time, but one interesting feature of the BBC system which may overcome this is the Tube architecture.

The Tube enables the heart of the machine – a 6502 processor – to be relegated to input/output processing and the main processing to be undertaken by a second processor. Early plans are for the second processor to be a Z80 microprocessor and, with this, the way is open to adopt the ubiquitous CP/M operating system. This has many critics, but its availability brings in its wake a wealth of existing application software. An efficient CP/M option *may be the determining factor for* many would-be purchasers of the BBC micro.

John Turnbull is manager of microsystems administration at the National Computing Centre, which co-ordinates the Federation of Microsystems Centres. *These centres, supported by* Department of Industry, offer an impartial service of workshops, advice and training on business systems. Further details from: the Microsystems administration unit, National Computing Centre Limited, Oxford Road, Manchester, M1 7ED



DOWN TO WORK

John Gordon sets up mailing lists and simple files on the BBC micro

For the first time user the BBC machine offers a very friendly introduction to computers – and can do some real work. A first task could be to set up a mailing list which involves: creating a file of names and addresses on tape; reading this information and writing it to the printer.

Using the BBC micro we create the mailing list as follows:

- Instruct the computer to open (for output) a file on the cassette tape. This gives the computer advance warning that you wish to write information onto tape. When a file has been opened, the computer gives it a channel number, and writes the file name onto tape. The BBC BASIC command for this is:

```
100 ch_no=OPENOUT("mail_list")
```

from now on the channel number **ch_no** is used to refer to the file.

- Once the file is opened, we can accept names and addresses from the keyboard and write them to the tape. We repeat this process until the last name, which is a special, recognisable name – **end_of_list**, perhaps. This would be coded as,

```
200 REPEAT
210 INPUT name$,address_1$,
    address`2$,address_3$,p_code$
220 PRINT#ch_no,name$,
    address_1$,address`2$,
    address_3$,p_code$
230 UNTIL name$="end_of_list"
```

Notice line 220, PRINT#ch_no writes the following data onto the tape. Lines 200 to 230 are continually repeated until the special name **end_of_list** is entered. Thus we can end up with a fairly extensive set of data on tape.

- At this point in the program, the computer does not know if all the data has been finished. Therefore the programmer must instruct the machine to close the file. Thus:

```
>300 CLOSE#ch_no
```

If we collect these three sections of code together we would have a program which could be used to create a mailing list on tape. As it stands, the program would not look very good – it would not be user friendly. The following program expands on the code to make it more usable. Notice the use of REM statements to make it self documenting.

```
100 REM  Mailing list J.Gordon,
120 REM  for the BBC micro
130 ch_no=OPENOUT("mail_list")
140 REPEAT
150 CLS :REM clear screen
160 PRINT "Enter name and address,
    use name=end_of_list to finish"
170 INPUT '"Name - "name$
180 INPUT '"Address_1 - "address_1$,
    '"Address_2 - "address_2$,
    '"Address_3 - "address_3$
190 INPUT'"Post Code - "p_code$
200 PRINT#ch_no,name$,address_1$,
    address_2$,address_3$,p_code$
210 UNTIL name$="end_of_list"
220 CLOSE#ch_no
230 END
```

When this program is run, the following appears on the screen:

```
>RUN
RECORD then RETURN
Enter name and address,
use name=end_of_list
to finish
Name - Jim Smith
Address_1 - 3 The Close
Address_2 - Paisley
Address_3 - Renfrewshire
Post Code - PA1 2BE
Enter name and address,
use name=end_of_list
to finish
Name - end_of list_list
Address_1 -
Address_2 -
Address_3 -
Post Code -
```

Thus we can make the program appear straightforward.

We now have the problem of getting the names and addresses off of the tape and onto sticky labels. The program in this case takes the following form:

- open the file for input. This is a similar instruction to open for output. The BASIC statement is:

```
100 ch_no=OPENIN("mail_list")
```

- Read a name and address from the tape and write it to printer. With the BBC micro, we have a very simple means of getting data onto the printer. We issue the command VDU 2, and all subsequent data PRINTed, will appear on both the screen and the printer. If we wish to stop printing we issue the command VDU 3. We can then keep on reading and writing names and addresses until we get to the last name (end-of-list). Thus:

```
200 REPEAT
210 INPUT#ch_no,name$,
    address_1$,address_2$,
    address_3$,p_code$
220 PRINT name$,address_1$,
    address_2$,address_3$,p_code$
230 UNTIL name$="end_of_list"
```

Notice in line 210, we are inputting from the tape (channel = ch_no), and PRINTing to the screen. If we are using the printer, we add the following two lines,

```
190 VDU2
240 VDU3
```

- Lastly, as before we close the file.

```
300 CLOSE#ch_no
```

The above pieces of code would enable the user to obtain a printout of the mailing list, but it must be fine-tuned to fit a sticky label. This is done by printing lines onto the label to get the names and addresses lined up (see program 1). When using a disc system, we do not need to know the value of the last name. The system is provided with an end-of-file function – EOF#. We can replace line 280 with:

```
>280 UNTIL EOF#ch_no
```

Program 1. This was used to set up the sticky labels reproduced on the right by a printer.

```
100 REM Sticky label print program
110 REM J.Gordon, M.E.D.C., Paisley, 1982
120 REM Written for the BBC micro
130 CLS
140 PRINT"This program prints the mailing
    listonto sticky labels"
150 PRINT"Load and rewind the correct tape"
160 PRINT"Make sure that sticky labels are
    in printer and aligned"
170 PRINT"Press any key to continue"
180 A$=GET$:REM Program pauses until key is pressed
190 CLS
200 PRINT"Press PLAY on tape"
210 ch_no=OPENIN("mail_list")
220 VDU2:REM printer on
230 REPEAT
235  REM Lines 250 and 270 are used to position printer
240  INPUT#ch_no,name$,address_1$,address_2$,address_3$,p_code$
250  FOR I=1 TO 3:PRINT" ":NEXT I
260  PRINT name$,',address_1$,',address_2$,',address_3$,',p_code$
270  FOR I=1 TO 3:PRINT" ":NEXT I
280 UNTIL name$="end_of_list"
290 VDU3:REM printer off
300 CLOSE#ch_no
310 END
```

Jim Smith
3 The Close
Paisley
Renfrewshire
PA1 2BE

Mary Jones
4 The Avenue
Paisley
PA1 4BY

John Scott
2 New Road
Glasgow

James Grant
5 The Crescent
Paisley
Renfrewshire
PA3 6GH

end_of_list

Thus we can see that it is not too difficult to use the tape operating system to hold files of data, and subsequently to retrieve that data. I leave it as an exercise to the reader to amend the second program to print out a selective mailing list, (use IF statements around about line 240).

One second application shows some of the limitations of a computer with only one tape cassette for data storage.

The simplest stock control system consists of the stock file, a file containing all transactions on the stocks (all the withdrawals and additions to stock) and a printout of all items which need to be recorded.

We would use the transaction file to update the stock file, and the updated stock file to produce a list of all items recorded. Thus the flowchart would be as in figure 1.

This is only part of the full system, there would have to be other programs to set up the transaction file, and to ensure that it was correct and in the correct order. But even with this restricted system we have problems. We see that the stock-update program requires the BBC micro to access three files simultaneously – but we only have one cassette unit. With the machine, in its present form, therefore, this type of program cannot be implemented. Of course with discs there would be no problem

However, if the stock file is not too large, then we could read the file into memory in the form of an array of data, then update this array from transactions on tape, and lastly dump the array back onto tape. Figure 2 gives the system diagram.

In this amended system we only need one tape at any one time. Before we go any further, let us consider what an array is. An array is simply a table of data held within the computer's memory. To hold an array in memory, the computer must be instructed to reserve space for it. This is done by using the DIMension statement. Thus:

```
100DIM name$(10)
```

assigns space for 10 items of information to be held in an array name$. To refer to any individual element in the array, we use:

```
200PRINTname$(3)
```

prints the third value of the array name$ onto the screen.

To print the full 10 values of name$, we would code:

```
200FOR I=1 TO 10
210PRINTname$(I)
220NEXT I
```

with this additional feature, let us construct a computerised system for a stock file holding the information: stock number; a description of the article; the number in stock; the minimum allowable stock level and the number of items to be recorded if necessary. Thus:

Stock no	Description	No in stock	Rec-order level	Rec-order quantity
1	Widget	10	5	5
2	Pofor	7	6	10
3	Duferry	11	4	6
4	What for	23	10	12
5	Thingies	13	5	4
6	Eh	8	2	4
7	Jiffies	18	10	20
8	What-you-call-ems	8	2	3
9	Bits	13	5	4
10	Pieces	8	3	9

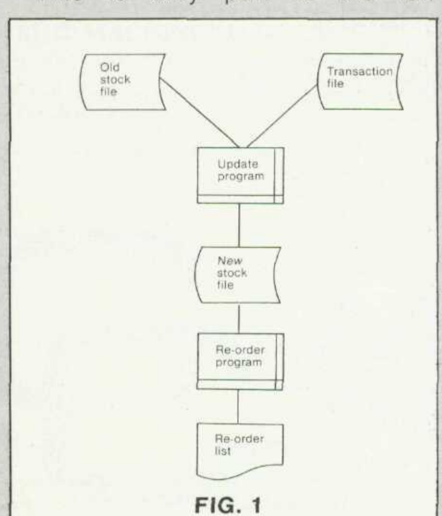


FIG. 1

Old stock file
Read into memory
Array of stock file
Transactions
Update program
Write to tape
Calculate & print re-orders
New stock file
Re-order list

FIG. 2



The transaction file is a file containing information regarding withdrawals from and additions to stocks. The format of the file is: stock number, code, quantity.

Notice the stock description is not held, only the stock number, which reduces the size of the file. The code is 1 for a withdrawal from stock, and 2 is an addition. We will assume that the data have been verified. For example, there is no stock number 11, say. The file contains the following information:

Stock Number	Code	Quantity
3	1	6
5	1	3
2	2	9
3	2	4
8	1	1
7	2	3
3	1	8
1	1	2

Program 2 can be used to update the stock file. The following printout was obtained using the given data.

```
Items to be reordered:
      3Duferry          1    4    6
```

A dump of the new stock file gave:

```
 1Widget               8    5    5
 2Pofor               16    6   10
 3Duferry              1    4    6
 4Whatfor             23   10   12
 5Thingies            10    5    4
 6Eh                   8    2    4
 7Jiffies             21   10   20
 8What_you_call_ems    7    2    3
 9Bits                13    5    4
10Pieces               8    3    9
```

If we do not have a disc unit available, then the maximum file size is limited by the memory available. With a disc drive, however, we can have fairly large files for holding data. But there are still limitations.

```
100 REM  Disc based stock-update program
110 REM J.Gordon, M.E.D.C., Paisley,1982
120 REM Written for the BBC Micro
130 REM This program reads a transaction
     file to update a master stock file
140 trans=OPENIN("transacts")
150 old_stocks=OPENIN("stock_file")
160 new_stocks=OPENOUT("new_stocks")
170 INPUT#trans,stkno,code,quantity
180 REPEAT
190         INPUT#old_stocks,stock_number,
    description$,no_in_stock,reord_level,
    reord_quant
200 IF stock_number=stkno THEN PROCupdate
210 PRINT#new_stocks,stock_number,
    description$,no_in_stock,reord_level,
    reord_quant
220 UNTIL EOF#old_stocks
230 CLOSE#trans
240 CLOSE#old_stocks
250 CLOSE#new_stocks
260 END
280 DEF PROCupdate
290 IF code=1 THEN no_in_stock=no_in_stock
     - quantity  ELSE no_in_stock=no_in_
     stock + quantity
300 INPUT#trans,stkno,code,quantity
310 IF stkno =stock_number THEN PROCupdate
320 ENDPROC
```

Program 2

The simplest means of holding a file on disc is to arrange all stock records to be held in sequence – a sequential file.

If we wish to process information held in a sequential file, then we must search for the required information starting at the beginning of the file and read records one at a time until the search is successful. In the last example, where the stock file was in memory, we did not have to use this approach. We were able to process the transactions without considering stock number sequence.

When using a sequential file on disc, we would normally sort the transaction file into stock number sequence thus:

Stock Number	Code	Quantity
1	1	2
2	2	9
3	1	6
3	2	4
3	1	8
5	1	3
7	2	3
8	1	1

We can take advantage of the order of the transaction file when we update the stock file. It is possible to update the stock file in one pass. Notice that stock item 3 has three transactions made against it. We have to take this point into consideration when we attempt to update the file.

The transaction file must be read independently of the stock file to handle multiple transactions on the same stock item. Program 3 will carry out this task. Notice the use of a recursive procedure to handle the problem of multiple transactions.

One of the most common requirements of a computer system is to retrieve information instantly. This would not normally be done using sequential files, as such processing would be rather slow, so we use random files.

Instead of reading the records in the form 1st, 2nd, 3rd, 4th . . . we could read them 4th, 17th, 2nd, 9th, 1st, 17th . . . with the possibility of reading a record more than once.

The programing involved is fairly complicated and will be considered in a later issue.

John Gordon is a lecturer at the Microelectronics Educational Development Centre in Paisley, Scotland.

```
100REM Stock Control System
110REM J.Gordon,M.E.D.C., Paisley,1982
120REM Written for the BBC micro
130REM This program is written
       as a series of modules
150REM The first section sets up
       space for the stock file
160REM The stock file is held in
       memory in the form of 2 arrays,
       the first being a string array
       to hold the descriptions
170REM The other is a 2 dimensional
       array containing the numeric
       data of the stock file


180DIM description$(10),numbers(10,4)


190REM We now read in the stock file
200CLS
210PRINT "Load stock file tape into
   cassette and  rewind"
220PRINT "Press any key when ready"
230a$=GET$
240PRINT "Press PLAY on recorder"
250stocks=OPENIN("stock_file")
260FOR I=1 TO 10
270INPUT#stocks,numbers(I,1),
   description$(I),numbers(I,2),
   numbers(I,3),numbers(I,4)
280NEXT I
290CLOSE#stocks
300 CLS
310PRINT "The stock-file in memory"
320PRINT"Remove Stock file and load
   transaction file,
   rewind if necessary"
330PRINT"Hit any key when ready"
340a$=GET$
350PRINT"Updating Stock-file"
360trans=OPENIN("transfile")


370REM The following section of
   code updates the stock
   file in memory
380REPEAT
390INPUT#trans,I,code,quantity
400IF code=1 THEN numbers(I,2)
   =numbers(I,2)-quantity ELSE
    numbers(I,2)=numbers(I,2)+quantity
410UNTIL EOF#trans


420REM Stock-file updated
430CLOSE#trans


440REM The following section of
   code prints all items to be
   reordered, and writes the new
   version of the stockfile to tape

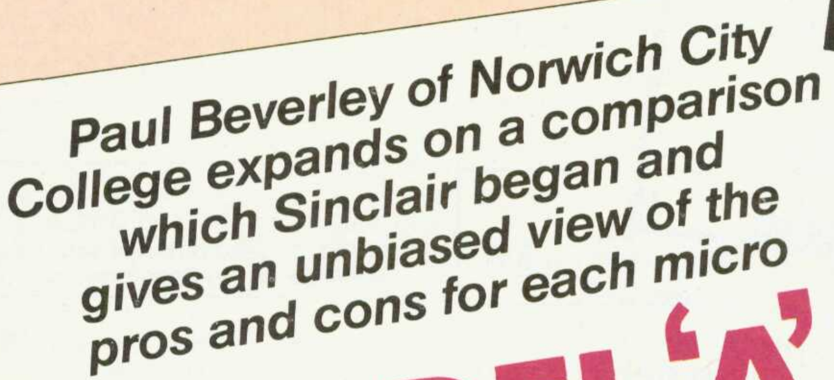


450CLS
460PRINT"Load fresh tape into
   recorder and rewind"
470PRINT"Ensure that printer
   is set up properly"
480PRINT"Hit any key when ready"
490a$=GET$
500CLS
510PRINT"Processing......"
520VDU 2:REM start printer
530PRINT"Items to be reordered:"
540new_stock=OPENOUT("stock_file")
550FOR I=1 TO 10
560PRINT#new_stock,numbers(I,1),
   description$(I),numbers(I,2),
   numbers(I,3),numbers(I,4)
570IF numbers(I,2)<numbers(I,3)
   THEN PRINT numbers(I,1),
   description$(I),numbers(I,2),
   numbers(I,3),numbers(I,4)
580NEXT I


590VDU 3:REM stop printout
600CLOSE#new_stock
610CLS
620PRINT "Job finished"
630END
```

Program 3. Ensures independent transaction file





MODEL 'A' OR SPECTRUM — that is the question

Comparisons are odorous, said the Immortal Bard, and so they are, especially when the person making them is biased. I'm sure you must have seen advertisements for the ZX Spectrum and noticed Clive Sinclair's comments on the relative merits of his and the BBC machine – but I think we must allow that he is a little biased! By the same token, since I am writing in a magazine called *Acorn User*, surely I am likely to be biased – the other way!

But I am not trying to sell either machine, I am also a previous owner of a ZX81, present owner of a Spectrum, and have a BBC micro. So I have had a chance to look at both sides. I shall be referring to the BBC model A, since that is the comparison originally made by Mr Sinclair.

Should we in fact be comparing these machines? The Spectrum costs only £125 whereas the BBC is £299. Well, maybe it isn't fair comparison, but what Uncle Clive started, others have continued. Tim Hartnell in his review in *Your Computer* said the specification of the Spectrum exceeds that of the BBC model A. As you make the factual comparison of the two machines, I think you will see this is just not tenable. However, although the Spectrum does not come out as favourably as some would like to think, you must remember that it costs less than half as much. Would you think it a fair comparison to look at the relative merits of a basic Mini Metro at £3,300 and a Rover 2600 at around £8,000?

I have set out the comparison in the form of three tables. The first is an expansion of the Spectrum advert, while the second and third show features each has which are not included as standard on the other. I shall make no comment on the facts at this stage – that is up to you.

The Spectrum, as indicated in Table 1, is expandable on board to 48k RAM, and it has address, data and control lines brought out on an edge connector ready for all sorts of peripherals. The ZX printers are already available, and an RS232



TABLE 1 – Comparison of features of the BBC model A and the ZX Spectrum.

	ZX Spectrum (16 k)	BBC micro, model A (16 k)
Price (inc. VAT)	£125	£299
Maximum RAM	48k	32k (96k with second processor)
Standard ROM Maximum ROM	16k 16k	32k 80k on board *256k on cartridges*
High resolution graphics	256 x 192 in 8 colours (7k RAM)	320 x 256 in 2 cols (10k RAM) *or* 160 x 256 in 4 cols (10k RAM) *or* 80 x 96 in 8 cols (1k RAM) (ie teletext mode)
RAM reserved for operating system	approx ½k	3¼k (includes 26 integer variables)
RAM left in high resolution mode for programs and variables	16 – 7 – ½ = 8½k	16 – 10 – 3¼ = 2¾k
maximum program and variable RAM in any mode	8½k	16 – 1 – 3¼ = 11¾k (teletext)
Text	32 x 24 (8 cols)	40 x 32 (2 cols) *or* 20 x 32 (4 cols) *or* 40 x 25 (2 cols) *or* 40 x 25 (8 cols)
Programmable characters	21	32 – 224
Processor	Z80A (3.5 MHz)	6502A (2 MHz)
Speed of Basic		Speed factor
Benchmark 1	4.9	1.0 4.9 x
Benchmark 2	9.0	3.1 2.9 x
Benchmark 3	21.9	8.2 2.7 x
Benchmark 4	20.7	8.7 2.4 x
Benchmark 5	25.2	9.1 2.8 x
Benchmark 6	62.8	13.9 4.5 x
Benchmark 7	89.9	21.4 4.2 x
Benchmark 8	25.1	5.1 4.9 x
Sound	single channel, frequency + duration	3 channels of tones + 1 noise, volume, frequency + duration, full enveloping (14 parameters)
Cassette interface	1500 baud + VERIFY + MERGE	1200 baud or 300 baud (verification possible using *CAT command) + automatic meter control *EXEC can be used for similar effect
Keyboard	40 calculator-type keys	73 full depression keys on a steel base plate

TABLE 2 – Spectrum features not standard on BBC model A

- BRIGHT
- CIRCLE
- BIN – direct entry of binary numbers
- PAUSE – an easy-to-use 'wait' statement
- CONTINUE – sadly lacking on the BBC micro
- copyright symbol ©
- single key entry of keywords

TABLE 3 – BBC features not available on the Spectrum

- Assembler, called from within Basic, full parameter passing
- Graphics and text windowing
- Procedures – fully recursive – local variables – parameter passing
- Direct entry and output in hexadecimal
- Real-time clock (Spectrum clock has to be accessed by PEEKs, POKEs and arithmetic calculations.
- Structuring facilities within Basic in addition to procedures:
  IF THEN ELSE
  REPEAT UNTIL
  ON GOTO
  ON GOSUB
- Word and string indirection (4 byte and string PEEKs and POKEs).
- 16 user-definable keys (yes, 16 – in O.S. 1.00 includes cursor keys and copy key.
- Other useful features:
  AUTO RENUMBER DELETE
  CHAIN *LOAD *SAVE *RUN
  *SPOOL *EXEC *ROM TRACE
  COUNT
- Integer variables
- ON ERROR GOTO, REPORT, ERR and ERL for comprehensive error handling
- Multi-line function definitions
- Facilities for logic and hexadecimal manipulation: (AND) (OR) (NOT) (not available as bit-wise operator on Spectrum). EOR MOD DIV TRUE FALSE
- Extra string handling facilities:
  INSTRING
  STRING$
  SPC
- Comprehensive file handling facilities:
  OPENIN
  OPENOUT
  PRINT#
  INPUT#
  PTR#
  EOF#
  CLOSE#
  BPUT#
  BGET#
  EXT#



serial interface is promised – but surely the most exciting single feature is the £50 microdrives, each of which will give 100k of on-line storage – and they are apparently going to be stackable. Then there will be interfacing units to enable you to run your micro-mice or model railways etc, and also speech synthesis units. Already, a number of companies plan to market add-on units.

The BBC model A, as it stands, is hardly capable of interfacing anything, but once it has all the sockets and plugs, it can be attached to serial or parallel printers, and a wide range of other possibilities. But before adding things outside the box, there is a fair bit that actually adds on inside the box:

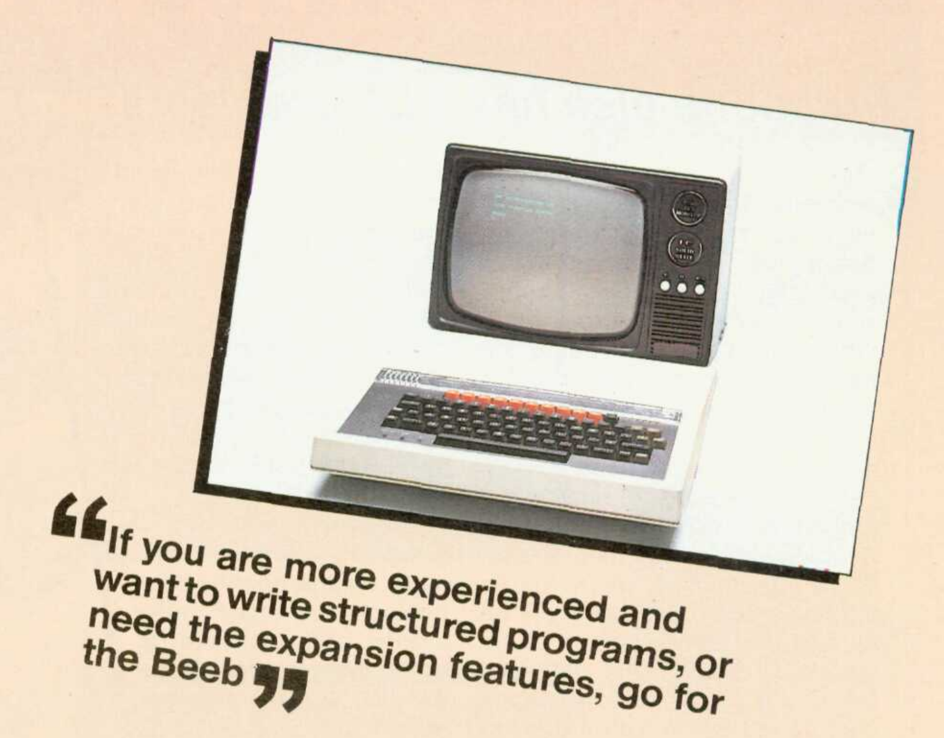
- disk *interface*,
- speech synthesis,
- Econet interface,
- plug-in ROMs for extra languages or toolkits
- ROM *cartridge interface giving* professional programs, extra speech vocabulary, alternative characters sets etc.

Then, in separate add-on boxes you will be able to get:

- teletext acquisition unit,
- Prestel acquisition unit,
- second processor – 6502 + 64k RAM, Z80A + 64k RAM with CP/M, or 16032 + 128k RAM.

If you want to follow up this theme, see the July issue of *Personal Computer World.*

Having put forward the facts, let me now give my own views. I don't think it makes sense to try to say one is 'better' than the other – it all depends what you are looking for and how much money you are prepared to spend. If you only have £125 *in* your pocket and want a colour computer then Sinclair has just what you are looking for! But suppose you have £300 to spend, is it necessarily better to go for the *machine* with the broader specification? I don't necessarily think so. Do you really need all the facilities the BBC machine offers?



"If you are more experienced and want to write structured programs, or need the expansion features, go for the Beeb"

If you are a more experienced programmer and want to write structured programs, or think you *may need* some of the expansion features, then you would be better to go for the BBC machine.

But if you are a complete beginner wanting to learn to *program and to play a few games,* then I think you'd be better off with a Spectrum, plus £175 to spend on peripherals and software.

On the educational front, to do anything other than use the microcomputer as a demonstration aid, you really need a decent pupil to micro ratio. Therefore it is quite tempting to compare the cost of ten Spectrums with four BBC model A's and *decide you'd rather* have a pupil-micro ratio of 3 to 1 instead of 7½ to 1. But there is a slight fallacy



"If you are a complete beginner and want to learn to program and play a few games, you'd be better off with a Spectrum"



Someone else has ULA problems

You may have heard about a problem Sinclair found which held up delivery of the first Spectrums. Well apparently it was a small problem with . . . yes, you've guessed it, the ULA! While the ULA was being re-designed,and so as not to disappoint the public, they have sent the computers out with a temporary modification. This consists of a small integrated circuit stuck onto the board with double-sided adhesive tape. Some of its legs are soldered together, and others are joined by bits of wire to a couple of the legs of the ULA. This does not seem to me to be an ideal way to do a modification for production machines, but I have been assured by Mr Bill Nichols of Sinclair Research that only 'a small number of thousands' of machines have gone out with the temporary modification; that so far they have not had any machines sent back with faults caused by the modification, and that as soon as the new ULAs become available they will be put into all new machines.

My main worry is that the heat generated by the voltage regulator will degrade the adhesive sufficiently for the chip to come unstuck. It may move around and short out on other components. However, Mr Nichols assures me that if this did happen within the 12-month guarantee, they would be repaired free.



Sinclair Research Limited

US Office:

sinclair

Paul E. Berverley Esq.,
Norwich College of Further &
Higher Education,
Ipswich Road,
Norwich,
Norfolk.
NR2 2LJ

26th July, 1982

Dear Paul,

Further to our telephone conversation last week regarding the ZX Spectrum I understand that you were able to rectify the problem which occurred with your machine.

I tried to contact you on Friday regarding the response you needed for the one major point on which you reserved criticism - namely the 'mod'.

I would assure that 1) the 'mod' is a temporary measure which will disappear shortly from production models on completion of redesign, and that 2) no machines with the fault which the 'mod' corrects have ever been issued to the general public.

Let me know if I can be of further assistance.

Best wishes,

Yours sincerely,

Bill Nichols.

in that argument. What about the cost of the colour monitor or TV, and the tape-recorder you will need for each micro, and what about the cost of software and of machine maintenance?

Also what is the rest of education going to do? If you swim with the tide then there will be far more support available, and far more educational software. If you look at the extra features available on the BBC machine, it seems to me that it is well worth the extra £175. Then what about the Acorn Electron? If that is going to be software compatible with the BBC machine and capable of linking into the Econet, then that would swing things further in favour of the BBC machine.

The other educational factor to be thought out is the Sinclair's single key entry, and here I can only give my own opinion. The major point in favour of single key entry, is not that it is easier for the beginner to enter whole keywords rather than typing them out on a conventional keyboard. Indeed, when each key has five or six functions, it is debatable whether it really is easier. Certainly for anyone with experience of conventional keyboards, it makes typing in programs extremely slow and laborious – at least initially.

But what does make the ZX series more friendly to the beginner is the fact that each line is checked for syntax errors before it is accepted.

My conclusion is that for the beginner – especially of the younger generation not yet acquainted with a conventional keyboard – nothing yet rivals the Spectrum's price. This will be doubly so if microdrives are on the market some way before their competitors. However, it will be interesting to see what the Electron will be like – I can only pass on the vague rumours coming from Acorn Computers. I hear that it will have 32k ROM, 32k RAM, various modes of graphics, though not as versatile as the BBC machine, and that in terms of price it will be a more realistic rival to the Spectrum

> **"The kids can use the Spectrum – I shall work with the Beeb"**

When will it become available? That I don't know. I would simply say that if I were in Acorn's shoes I would be pulling out all the stops to get it into volume production for Christmas. My feeling is that Christmas 1982 will be an extremely important time in the fight for the UK market in small micros.

As far as education is concerned, I don't think the Spectrum has much of a chance – but I may be wrong. It depends to some extent on when the Electron becomes available, and exactly what features it has. In particular I feel it is extremely important that it should have an eight-bit port – not just the address and data lines as on the Spectrum and ZX81. In my experience, schools are really beginning to wake up to the importance and potential in educational terms of getting kids wiring up their computers to the outside world.

Spectrum versus BBC? – I hope I've been able to put forward a few helpful facts to help you compare the two machines. It's up to you to sort out what suits your pocket and your application. In my household, I shall be working on the BBC machine and the kids can use the Spectrum!

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*These prices include fitting – send or bring in your machine for upgrading.

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BBC Machine dust covers	£5.75 (+ £1 p+p)

Books

BBC 30 hour BASIC	£5.50 (+£1 p+p)
Practical Programs for Atom & BBC	£5.95 (+ £1 p+p)
BASIC Programming on the BBC Micro	£5.95 (+ £1 p+p)
Programming the 6502	£11.75 (+ £1 p+p)

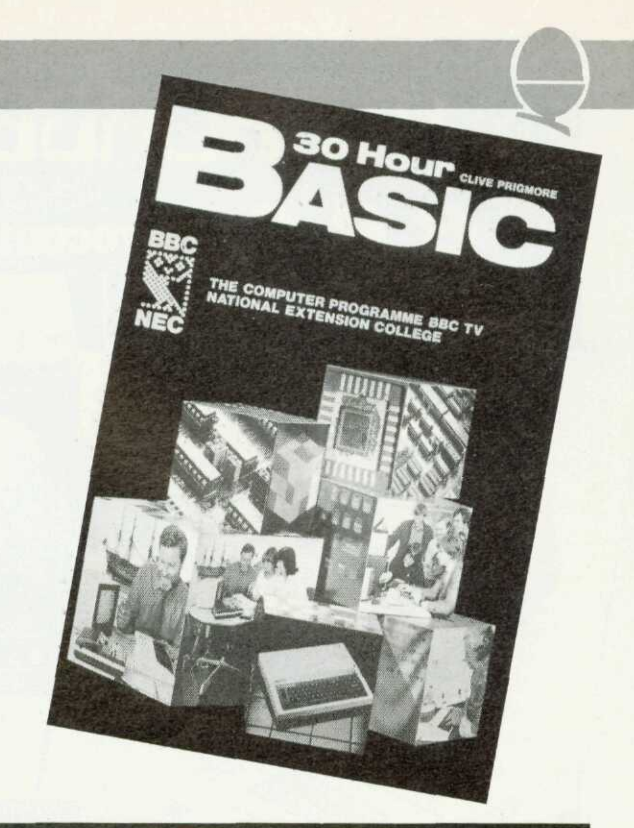
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Catering for a motivated minority



Richard Freeman of the NEC explains the history of 30 Hour Basic

The *30 Hour Basic* course predates the BBC micro in some senses. In 1980, the National Extension College decided that in view of the growth of interest in mircocomputers, it should develop a course in programming. The college already had such courses, but they were for mainframe systems and were declining in popularity. It was clear that a course for home owners of micros would have more appeal.

So work started on a course aimed at the home correspondence student or students in schemes run by local colleges. Then in late 1980, the college and the BBC became aware of each other's activities.

At that stage the BBC project was little more than a title, *Hands on Micros* and everything was a total muddle. It was computers for the masses – hardware, programming, applications, industrial revival, education. There might be a BBC book; there might be a BBC computer. Bit if there was a computer, would it be the main feature of the series?

No one knew what computer literacy meant – perhaps no one yet does! But in the BBC and NEC some people had long associations with literacy (from *On the Move*), numeracy (with the NEC/YTV *Make it Count* and *Numbers At Work* series and the BBC *It Figures* series). Was computer literacy like that? And, more important, did computer literacy mean being able to program a computer?

This latter point was vital to the project and remains crucial to how educationists are approaching the use of computers in schools and colleges. It is glibly said by many – usually not owners of micros – that soon there will be a computer in every home. It is then assumed that everyone must learn to program a micro.

The first assumption is probably false, the second definitely so. Take the first: long before most families get round to purchasing a micro, they will be offered cheap, intelligent viewdata terminals. Once these are available, most homes will have no use for a separate micro. Instead, the power of many computers will be available to people who own (or rent) little more than a keyboard.

The second false assumption was more important to how thoughts developed on the NEC course. It requires only a brief acquaintance with programming to appreciate that only a small proportion of the population would ever find it beneficial to learn programming. They might program for interest but there are few problems in home life that justify writing your own program.

Once that conclusion was reached, the role of an NEC course to accompany the BBC series became clearer. If the BBC series were to be 'computing for the masses', it could not be more than casually concerned with programming. But the less it was concerned with programming, the more there needed to be another part of the project that provided the chance to learn programming.

That was what the NEC was planning before the BBC discussions, so why all the agonising about what to teach? The answer lies in the highly innovatory nature of the project. No other nation has run a computer literacy project so it had to be carefully thought through.

Having decided that the NEC course should concentrate on programming, the next question was which language was it to be? This was a decision the BBC eventually made, opting for Basic because most micros provide it rather than, say, Comal because most micros ought to provide it. Without a BBC micro, the language would

have to have been Basic. What has not been so clear to critics is that even with a BBC micro, the language still had to be Basic. If it had been any other choice, a mass appeal project to interest all machine owners would have become a buff's corner for those who, by *definition, had no need of the* project.

To settle on Basic was one thing. To decide on a dialect, quite another. Here we came up against a classic problem of collaborative projects. In early 1981, the BBC's schedules necessitated fixing on a choice of machine. But already the NEC's schedules necessitated that piloting of the course be well on the way. So we wrote and piloted the course using a Superbrain. Then the timescales of the NEC course and the BBC micro became increasingly incompatible. This became a *dominant factor in the dialect* decision. We started with the assumption that once the BBC Basic was clear, the course would follow that Basic. But after running two pilot version of the course in a local college, there was still no sign of a BBC micro nor of a definitive language. By May 1981, final decisions had to be made at NEC if an October publication was to be kept to. (At that stage, October 1981 was still the BBC transmission date.) So with no other choice, *30 Hour Basic* was going to have to go to press at roughly the same time as an emulator for the BBC micro was to become available.

This then, by default, settled the issue and we chose a minimal version of Basic that would run on most micros. Only when the course was perfected in that version was it checked out on a BBC emulator so that notes on BBC Basic could be added.

The final *30 Hour Basic* course is a self-contained (but add your own micro) course of nine study units. It introduces all the major features of Basic up to and including simple file-handling through a step-by-step learning sequence. That in the end has proved to be the course's contribution to computer education – its learning structure. There are hundreds of books that will tell you the syntax of Basic, but few show any sign of being written by someone who appreciates the problems of learning by yourself – which is what the NEC specialises in.

The other major feature which stands the course apart from others is that it puts a heavy emphasis on problem solving and program structure. Beginners may wonder why this is necessary, and the answer lies in what is beyond. Almost any fool can string together 20 lines of syntactically correct Basic which run. But unless those lines are programmed against a clear understanding of the need for good structure, they will not successfully extend to 200 lines. *30 Hour Basic* lays the foundation for this extension.

It is too early to evaluate the course and its contribution to the BBC project or to programming education but some points can be made.

First, we were right about dialect – we were pushed into producing a Sinclair ZX81 edition which has sold in enormous quantities.

Second, we were right to assume that amongst the BBC audience there would be a motivated minority who would wish to master programming. They do not just want an acquaintance with programming, but to solve real problems. These are the people who have chosen to take the course and they would have felt cheated with anything less substantial than we have given them.

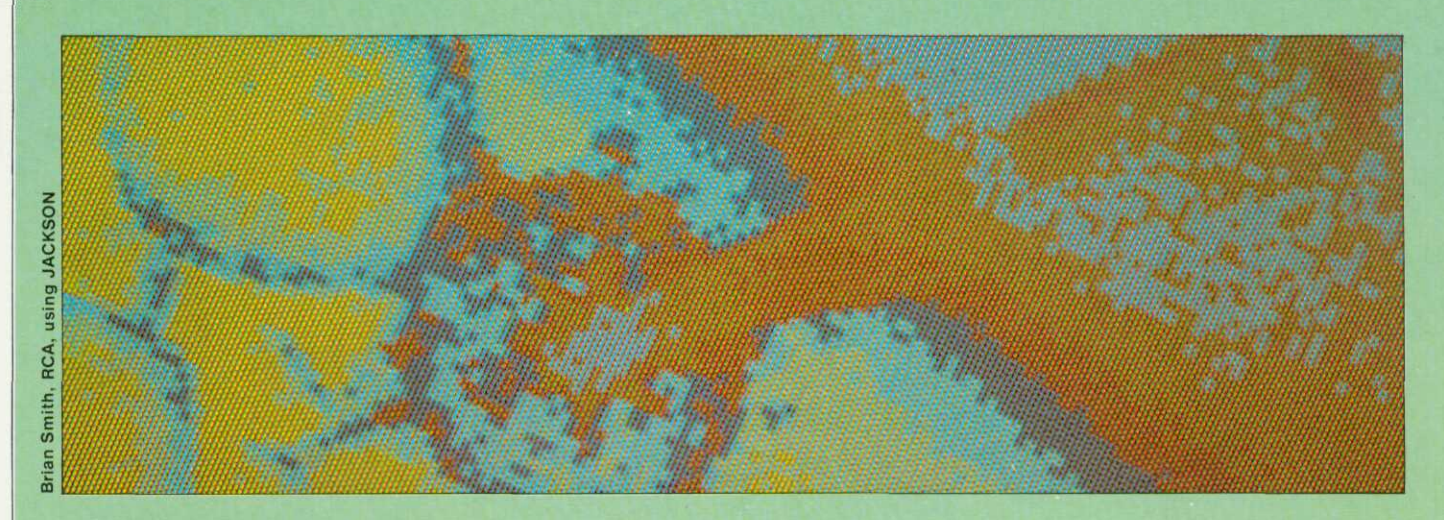


Clive Prigmore, author of the NEC book *30 Hour Basic* produced to complement the BBC Computer Literacy Project. Below, the College's headquarter in Cambridge.



***30 Hour Basic* is available for £5.50 (post free) from the National Extension College, 18 Brooklands Avenue, Cambridge, and from bookshops. Two cassette tapes of the programs in the courses are available from the NEC, £5.95 (post free) each. Many local colleges run courses based on the course. For details write to BBC Computer Literacy Project, PO Box 7, London W3 6XJ.**





Brian Smith, RCA, using JACKSON

JOIN THE REVOLUTION

Art isn't as simple as making pretty pictures on a screen, says Brian Reffin Smith. He points the way, and outlines some possibilities the BBC micro suggests



This article is not exactly about how to make art with a BBC computer. That problem is no different from the more general one that every art student, great artist or weekend painter is faced with: how to make art at all.

We should distinguish between images and art. Just because you can have fun with random numbers or spirals on a TV screen, that doesn't necessarily make very significant art. So this piece sets out to do three things.

First, we'll look at the general context for art done by, with, or sometimes in spite of, computers. Second, we'll examine some of the possibilities the BBC microcomputer suggests: what are its special characteristics? Finally, there are a few suggestions, pointers towards what you might consider doing, using your computer, to make art.

So-called 'computer-art' has been going for about 30 years – ever since computers became available. But most of the work has been done by people who were often better at computing than art. A mathematical formula or transformation that produced an interesting-looking graph or perhaps a whirling spiral, was seized upon, framed on the wall, and labelled 'art'. It is arguable, though, that if it had been done with a Spirograph, or by doodling with eyes shut, people would hardly have given it a glance.

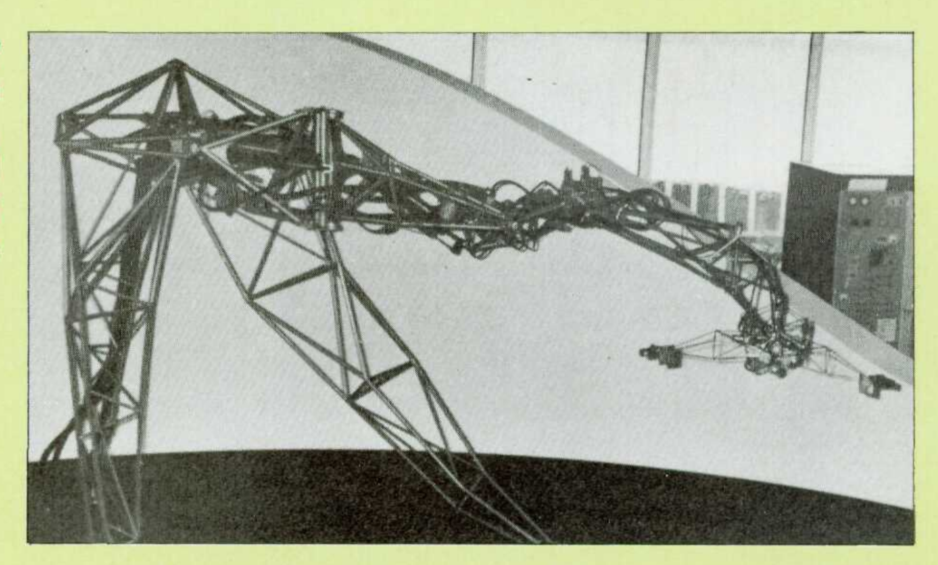
So if we are interested in what computers in general, and the BBC micro in particular, can do to help us make art, we have a dual responsibility. Not only must we get the computing right, but also the art should, at the very least, not bore rigid those who just see it, having missed the (very wonderful, no doubt) process that created it.

Ah! But there's a thought! Perhaps if we actually made the process itself the artwork . . . then people could get more involved. Well – yes. And some of the most celebrated pieces of technological art have made quite clear, and have actually used, the process and systems 'behind' the artwork.

Take Edward Ihnatowicz's famous 'Senster' shown overleaf. This piece of – what, sculpture? – was quite clearly a mechanical device, linked to a computer. It vaguely resembled a 3-legged pneumatically-powered giraffe, but all its workings



Senster vaguely resembled a three-legged, pneumatically-powered giraffe, with all its workings visible



were visible. The computer was programmed to make the thing go towards gentle movements or sounds, but to avoid violent moves or loud cries.

It used microphone 'ears', and radar 'eyes'. Perhaps just because there was a conflict between what it looked like (technological) and how it acted (animal-like), people would stand and watch it for hours at a time. Yet the program in the computer was, in essence, simpler than most graphics programs.

Gerald Hushlak is a Canadian artist who often uses computer graphics in his works. Living in Calgary, a city rich in graphics information technology because of the oil exploration boom (oil companies need to visualise masses of data), he has access to some very sophisticated equipment. But the techniques he uses are available to anyone with a BBC machine and the imagination.

Briefly, he gets the computer to construct an image that is partly random, partly made up of predefined elements. This is processed in such a way as to produce a whole series of images, each bearing some relationship to the one before, and also to the totality of images. Elements are enlarged, reduced, moved around, combined . . . and again, the 'thinking' (his and the computer's) is made visible.

His work does not rely on a single image – none of the individual frames might be thought particularly stunning – but it is the process of production that he exhibits.

Here, at last, is where we, with small computers, can score heavily. For virtually anything we choose to do with the machine is, by definition, all process! We have to lay open the series of events and decisions which we will use to achieve some result – because that is the program. We may attempt to conceal it from others, but we ourselves cannot possibly avoid it.

Let's consider some of the things the BBC computer can do, that we can use – sticking as closely as possible to that idea of process.

Process implies change, and the powerful graphics of the BBC machine are just what we need. In the old days, you could just light up parts of the screen, individual 'pixels'. Then – wonder of wonders – you could draw lines!

But now, we have the choice of at least 47 ways of drawing anything: that being the number of different PLOT commands Suppose we have, incorporated in a program as a series of DATA statements, numbers specifying the horizontal and vertical co-ordinates of a series of lines.

If we draw those out using DRAW (ie PLOT 5), we get a line shape, in whatever colour we choose. But let's see what else we can do – and imagine the resulting images being photographed, framed, and gradually building up into a huge series for our retrospective show at the New York Museum of Modern Art (well why not?)

Suppose we use PLOT 1 instead of DRAW. This draws a line 'relative', in the current colour. This means that the *x* and *y* values of the line's endpoint are not measured on the screen like a piece of graph-paper, from the 0,0 origin at bottom left, but are added on to the measurements of the last point. In other words, if we were last 'at' 40, 50, and the new line is PLOT 1,100, 100 then a line will be drawn to position 140, 150. This will then be the starting position for the next line, and so on.

As an amazingly difficult exercise (humans weren't built for this kind of thing!) try to imagine a simple shape (say a square) drawn out in the ordinary way, and then using PLOT 1. What happens to it?

Picking almost at random from the list of PLOT commands in the BBC manual, we might then try PLOT 86. This not only draws a solid triangle between the last three points 'visited', it also does it in the logically inverse colour to what was already there. And by use of the GCOL command, we can choose to draw in 'exclusive or' mode (immediately doubling the 47 options.)

So not only do parts of the drawing become solid (and probably not like we'd imagine, either), but also the colours change when the solid areas overlap.

This is advanced stuff – I mean the art, not the graphics; see how we've really got things going for us? What we've done is to restructure the relationships between

the various parts of the image. No longer does line follow line, like a history book or a story, in a linear way.

Instead, parts of the image interact with previous parts, where the triangles overlap, spilling out of the sparse, thin little lines. And all by changing PLOT 1 to PLOT 86!

This is of some interest, even if you consider the drawing just as a picture. But think! A picture must be of something. So it isn't just lines or bits of colour we're altering – it's actually little bits and pieces of meaning. If you want an analogy, the lines themselves are just like the sounds in the words used to tell a story – but who ever remembered a good story because of the 'w' sound in 'wolf'? It's the story's meaning that counts, and whether Little Red Riding Hood got eaten or not.

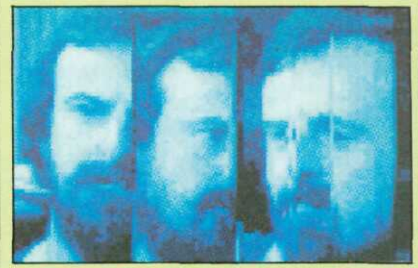
When I began this piece, I thought that I'd be mentioning all sorts of PLOT commands, routines for doing this and that, maybe show a photo of an image produced by a short program. But really, that's unnecessary. For the truth is, there are so many good articles around on how PLOT works; and lots of programs that will make circles or move squares. The BBC manual itself – the revised version – is pretty good too.

So I ended up by just trying to tell you about one or two of the things that I think are really important in making art with a computer. See if you agree.

Another point is that 'really', the art doesn't matter much either. It's the ideas, and how they change us, that matter. There's never been such a potentially powerful combination, to do things like that, as you and your computer.

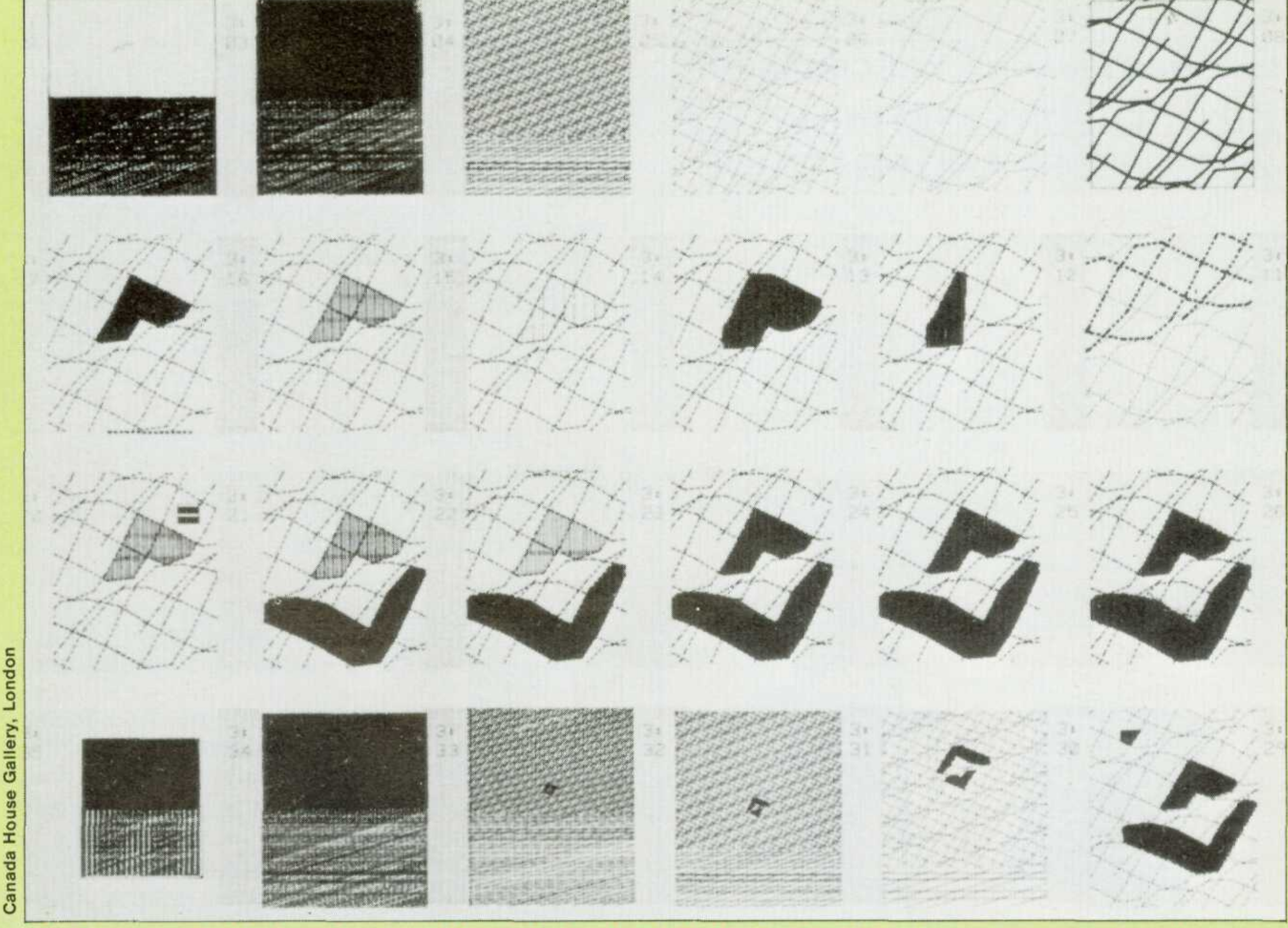
If there are two categories of people that can get away with almost anything (for all the wrong reasons, I know, but let's use it!) it's artists and computer people.

So welcome to the revolution. (Technological? Art? Political? If you can separate them, you choose.)



Brian Reffin Smith works in the Royal College of Art's design research department. He wrote the BBC software on Drawing and Painting, now available. Although simple, these will help develop the techniques in this article. The Painting package simulates air-brushing and produces three-dimensional effects. The Drawing software explores shapes, patterns and colour.

Details of the Painting and Drawing cassettes can be obtained from BBC Publications at 35 Marylebone High Street, London W1M 4AA. They run on both model A and B machines.


Canada House Gallery, London

Hushlak . . graphics use sophisticated equipment, but his techniques are open to all



Wake up to the SOUND of MUSIC

Even if you're not Mozart, writing music is fun on the BBC micro. This month Joe Telford gives you some ideas on playing tunes and using the keyboard as an organ.

Making sounds with the BBC Micro is easy – despite what you may have heard. The harder part is to turn the noise into music. The last issue covered sound effects, so here we experiment with notes; playing tunes and turning your keyboard into an organ.

The SOUND command has four major parameters: voice control C; amplitude, A; pitch control P; duration D. It can be expressed in terms of these parameters as SOUND C, A, P, D.

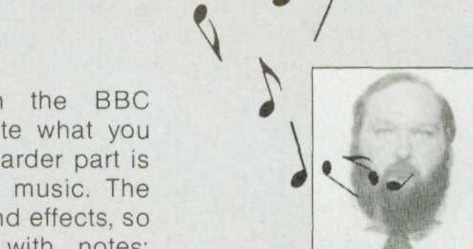
In its simplest form, the voice control can be in any channel from 0 to 3, the amplitude (volume) may be a value from 0 to -15, the pitch control may be a note from 0 to 255 and the duration may be a time in units of 1/20 s from 0 to 255. So:

```
Sound 3, -15, 101, 20
```

will play voice 3 at full volume on top C for one second.

Before we can produce notes, we need to know the relationship between the pitch control numbers and the actual notes played, which is shown overleaf. Apart from the lowest note (A#) with value 0, the remainder of the notes have a gap of 4 units per semitone. This arithmetic sequence indicates that octaves will occur at intervals of 48 ie (gap of 4 multiplied by 12 semitones in an octave). Program 1 uses the simple SOUND command to generate the 12 semitones of a chromatic octave from middle C.

By altering the 53s in line 20, it would be possible to play a chromatic octave from any note. For example from G, simply exchange the 53s for 81s.



To further consider the production of scales, look at program 2. The gaps between notes in major octaves are regarded as whole tones or semitones, and a complete scale is made up of the combination of tones (T) and semitones (S) of line 20. The * is simply a reference point for the first note and could have been any symbol (other than T). Line 60 examines which type of gap (T or S) is being played and increments the note value by four, so tones have gaps of eight while semitones are gapped as 4. We can play a scale in any key – input 53 in response to line 30 gives the key of C, while a value of 73 would give F major and 61 would give D major.

Let us look again at the voice control parameter of the SOUND command. Type this simple program.

```
NEW
10 SOUND 1, -15, 53, 20
20 SOUND 2, -15, 69, 20
30 SOUND 3, -15, 81, 20
RUN
```

The result is a fairly pleasant, though slightly fuzzy chord in C major (C, E, G). Now replace line 10 with:

```
10 SOUND &0201, -15, 53, 20
```

and run the program. Now we have a much crisper chord. To explain this, the voice control parameter should be regarded as a 4-byte hexadecimal number (hence the & prefix).

The four bytes from which this number is constructed are labelled &HSFC. The most significant byte is labelled H for maintain. It is set to 0 for normal SOUND statements, but could be set to 1 if an envelope is in use. In this case the final stages of the previous note would be maintained under envelope control while the note containing H would not sound.

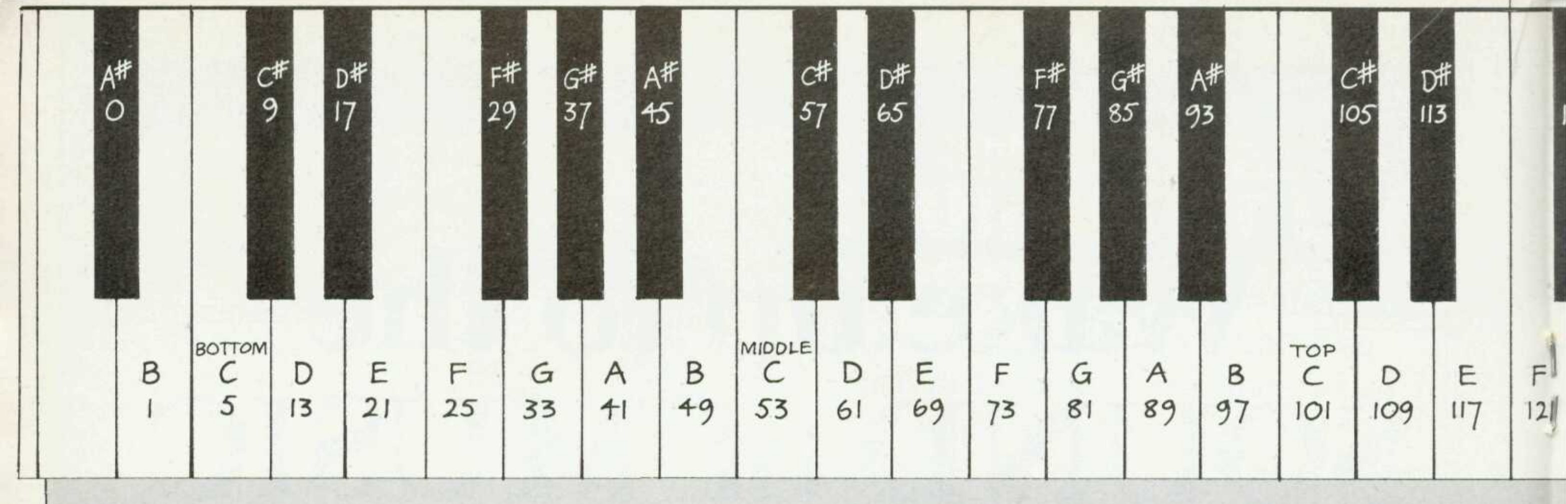
Byte 3 – S – produced the crisp chord above. When set to 0, each note is sounded depending on its place in the sound queue, hence 2 voices sounded in order appear slightly fuzzy. Because S is a mnemonic for synchronise, setting S as follows causes the effects overleaf

Program 1

```
10 REM CHROMATIC OCTAVE
20 FOR note = 53 TO (53+48) STEP 4
30   SOUND 1,-15,note,5
40   NEXT
```

Program 2

```
10 REM STANDARD OCTAVE
20 DATA *,T,T,S,T,T,T,S
30 INPUT"WHICH NUMBER TO BEGIN (53 FOR C)",start
40 FOR note = start TO (start+49) STEP 4
50   READ value$
60   IF value$="T" THEN note = note + 4
70   SOUND 1,-15,note,5
80   NEXT
```



S = 0 voices take their turn in the queue.
S = 1 this voice and next voice sound together.
S = 2 this voice and next 2 voices sound together.
S = 3 this voice and next 3 voices sound together.

Byte 2 is normally set to 0 when it allows the next note to play its full length. If set to 1, all sounds in the queue are removed and the note containing this byte is played immediately.

The final byte C for channel is the easiest to understand. It can take the values 0, 1, 2, 3 and refers to the voice to be sounded. The parameters &HSFC can be used in any combination although &FC combinations and &SFC combinations especially are dealt with in this article.

The SOUND command is a good example of the actual parameters for a musical note. We have



Note Name	Duration
semiquaver	2
dotted semiquaver	3
quaver	4
dotted quaver	6
crotchet	8
dotted crotchet	12
minim	16
dotted minim	24
semibreve	32

Figure 1. Note the duration of each note.

examined the voice parameter and the pitch parameter, but before we produce musical tunes we need to examine the duration of each note.

Figure 1 gives a list of parameters for duration referring to commonly used time values. So:

SOUND 2, -15, 101, 8

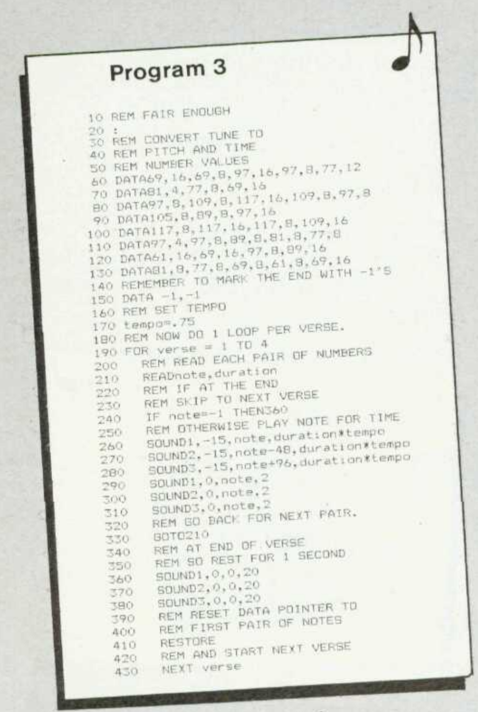
would play top C as a crotchet (at a rate of 150 crotchets per minute).

The best source of 'easy to convert' tunes is simple organ books. The first stage of conversion is to write each tune as letters, then use the art work above to convert to numbers. To each pitch number thus found we make up a pair by adding the duration of the note as found by using the keyboard given above. The next stage is to write the pitch duration pairs into DATA statements from which a program can produce a tune. Examine program 3, which plays a particular tune, found in the DATA statements of lines 60 to 130. Replacing the numbers with your own would change the tune. It is useful to end each tune with a value which the computer can easily check, hence the -1 data at line 150.

Because tunes have different tempos or speeds, although they may all have quavers, we may need to speed up or slow down every duration code by the same factor. Line 170 sets the tempo to 0.75 which slightly speeds up the tune. Experiment with values for the tempo of 0.5, 1, or 2, to achieve the best result.

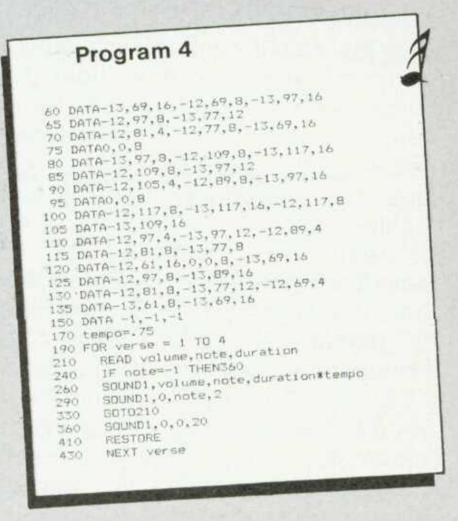
Although the program is well explained by REM statements it is worth examining the SOUND commands. To gain a pure single sound, lines 270, 280, 300, 310, 370, and 380 can be omitted. However, their inclusion with voice 2 playing bass (note -48) and voice 3 playing high octaves (note +96) and without the T parameter of the voice command being set, gives an old-fashioned fairground organ sound. Lines 290 to 320 are essential to separate notes with short gaps of silence. Remove lines 290 to 320 to fully appreciate their value. Lines 360 to 380 give a rather longer silence at the end of each verse.

Finally, the number of verses can be altered at line 190. There is a great deal of value in this type of program as it can be adapted to any tune. Unfortunately it has two main faults. The first is that at the end of musical phrases there is normally a slight pause – but not in program 3. The second is that program 3 cannot play accented notes. An accented note is a note played at a louder volume for



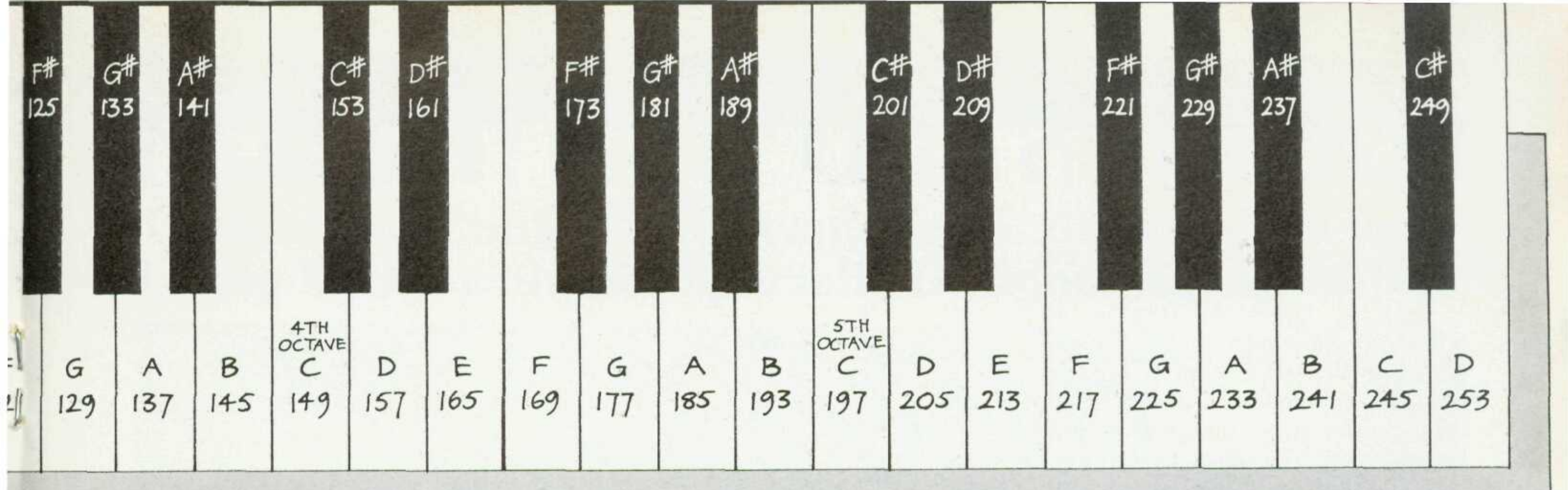
Program 3

```
10 REM FAIR ENOUGH
20 :
30 REM CONVERT TUNE TO
40 REM PITCH AND TIME
50 REM NUMBER VALUES
60 DATA69,16,69,8,97,16,97,8,77,12
70 DATA81,4,77,8,69,16
80 DATA97,8,109,8,117,16,109,8,97,8
90 DATA105,8,89,8,97,16
100 DATA117,8,117,16,117,8,109,16
110 DATA97,4,97,8,89,8,81,8,77,8
120 DATA61,16,69,16,97,8,89,16
130 DATA81,8,77,8,69,8,61,8,69,16
140 REMEMBER TO MARK THE END WITH -1'S
150 DATA -1,-1
160 REM SET TEMPO
170 tempo=.75
180 REM NOW DO 1 LOOP PER VERSE.
190 FOR verse = 1 TO 4
200   REM READ EACH PAIR OF NUMBERS
210   READnote,duration
220   REM IF AT THE END
230   REM SKIP TO NEXT VERSE
240   IF note=-1 THEN360
250   REM OTHERWISE PLAY NOTE FOR TIME
260   SOUND1,-15,note,duration*tempo
270   SOUND2,-15,note-48,duration*tempo
280   SOUND3,-15,note+96,duration*tempo
290   SOUND1,0,note,2
300   SOUND2,0,note,2
310   SOUND3,0,note,2
320   REM GO BACK FOR NEXT PAIR.
330   GOTO210
340   REM AT END OF VERSE
350   REM SO REST FOR 1 SECOND
360   SOUND1,0,0,20
370   SOUND2,0,0,20
380   SOUND3,0,0,20
390   REM RESET DATA POINTER TO
400   REM FIRST PAIR OF NOTES
410   RESTORE
420   REM AND START NEXT VERSE
430   NEXT verse
```



Program 4

```
60 DATA-13,69,16,-12,69,8,-13,97,16
65 DATA-12,97,8,-13,77,12
70 DATA-12,81,4,-12,77,8,-13,69,16
75 DATA0,0,8
80 DATA-13,97,8,-12,109,8,-13,117,16
85 DATA-12,109,8,-13,97,12
90 DATA-12,105,4,-12,89,8,-13,97,16
95 DATA0,0,8
100 DATA-12,117,8,-13,117,16,-12,117,8
105 DATA-13,109,16
110 DATA-12,97,4,-13,97,12,-12,89,4
115 DATA-12,81,8,-13,77,8
120 DATA-12,61,16,0,0,8,-13,69,16
125 DATA-12,97,8,-13,89,16
130 DATA-12,81,8,-13,77,12,-12,69,4
135 DATA-13,61,8,-13,69,16
150 DATA -1,-1,-1
170 tempo=.75
190 FOR verse = 1 TO 4
210   READ volume,note,duration
240   IF note=-1 THEN360
260   SOUND1,volume,note,duration*tempo
290   SOUND1,0,note,2
330   GOTO210
360   SOUND1,0,0,20
410   RESTORE
430   NEXT verse
```



emphasis. Try clapping the rhythm of 'Jack and Jill went up the hill' to hear the accents on certain beats.

To bring the BBC micro's sound production closer to music performed live by people, it is necessary to rectify both these faults.

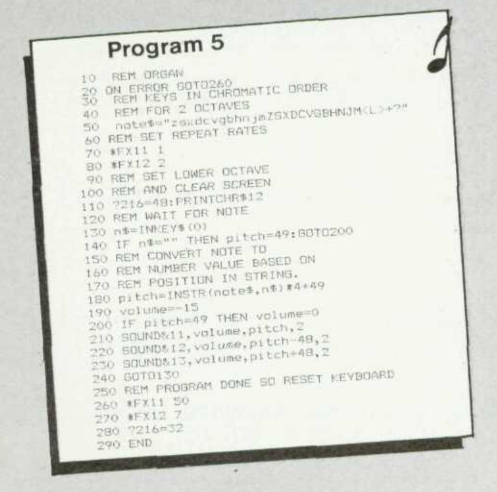
One solution is found in program 4, where we enter 3 figures for data on each note:

- volume (-12 for normal and -13 for accent),
- pitch (as program 3),
- duration (as program 3 except in some cases where I finally got my dotted crotchets correct).

Some lines (eg 75) contain an 0, 0, 8 DATA statement which effectively says 'rest for a crotchet of time', and occurs at the end of musical phrases.

Moving on from this area of canned music, the BBC micro can be a very versatile musical instrument for live performances. Program 5 is my attempt to improve on the organ of the *Welcome Pack*. However, I have made no attempt to produce colours to match.

Two main problems exist when using the BBC machine as a keyboard instrument. The first is that each note sounds for a set length of time, and the second is that because of the type-ahead facility on the keyboard, notes can play on long after fingers have been removed from the keys. Shortening the note duration and relying on the auto repeat facility gave a drill-like effect, as in my prototype program.



Program 5

```
10 REM ORGAN
20 ON ERROR GOTO260
30 REM KEYS IN CHROMATIC ORDER
40 REM FOR 2 OCTAVES
50 note$="zsxdcvgbhnjmZSXDCVGBHNJM<L>+?"
60 REM SET REPEAT RATES
70 *FX11 1
80 *FX12 2
90 REM SET LOWER OCTAVE
100 REM AND CLEAR SCREEN
110 ?216=49:PRINTCHR$12
120 REM WAIT FOR NOTE
130 n$=INKEY$(0)
140 IF n$="" THEN pitch=49:GOTO200
150 REM CONVERT NOTE TO
160 REM NUMBER VALUE BASED ON
170 REM POSITION IN STRING.
180 pitch=INSTR(note$,n$)*4+49
190 volume=-15
200 IF pitch=49 THEN volume=0
210 SOUND&11,volume,pitch,2
220 SOUND&12,volume,pitch-48,2
230 SOUND&13,volume,pitch+48,2
240 GOTO130
250 REM PROGRAM DONE SO RESET KEYBOARD
260 *FX11 50
270 *FX12 7
280 ?216=32
290 END
```

The solution was to adjust the repeat rate – as detailed in the previous edition to give a fast repeat instantly, (lines 70, 80) and then to use the &IV parameter (lines 210 - 230) so that sound was continuous but the effect of stopping playing was instantaneous.

The program generates my fairground organ over a good two octaves range, changeable from lower to upper octaves via the shift lock key. Because of the adjustment to repeat rates they are reset on ERROR or on ESCAPE. *Look at figure 2. This gives the* layout of the keys used for each octave so that 'z/C' means lower case z plays a C in the lower octave, while '?/E' means ? plays an E in the upper octaves with shift key down.

Figure 2 will therefore let you convert music from a tune book to the keys of your BBC micro. By way of starting off a BBC tunebook, I offer figure 3 as tune no 1. Make sure the shift lock LED is lit, then play the notes shown – you should pick up the rhythm quickly as the tune seems to be fairly well known.

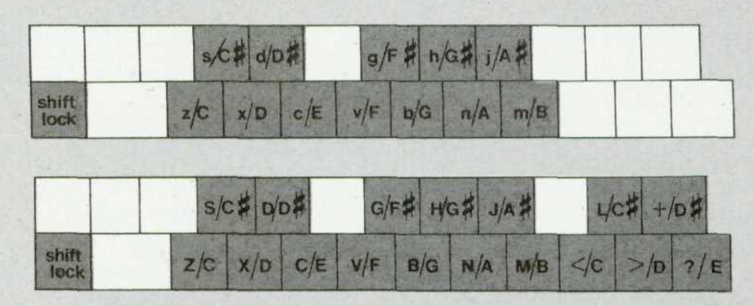


Figure 2. Diagram of keys used in organ program. Switching between octaves is done using Shift lock.

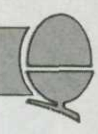
Envelopes, as the name suggests, are useful ways of packaging sounds so that the waveform has an overall shape. The ENVELOPE command is a convenient way of controlling both pitch and volume of a sound, though its use requires careful forethought. It is followed by 14 parameters:

ENVELOPE N, T, P11, P12, P13, PN1, PN2, PN3, AA, AD, AS, AR, ALA, ALD

The ENVELOPE *commands* only appear to work during a SOUND command, so that SOUND 1, 4, 101, 20 plays voice 1 with the basic frequency of top C for one second. During that second it is under control of envelope 4. You can generate up to 4 envelopes to work simultaneously, numbered 1 to 4 in parameter N of the ENVELOPE

Z X C V V V V V V V C X Z
Z X C V V V B B N
N N N J J B V B N B V
Z Z Z X C V
< < N < < N < > < J N J
J J B J J B J <
< < N < < N < > < J N J
N B V Z V C V B V

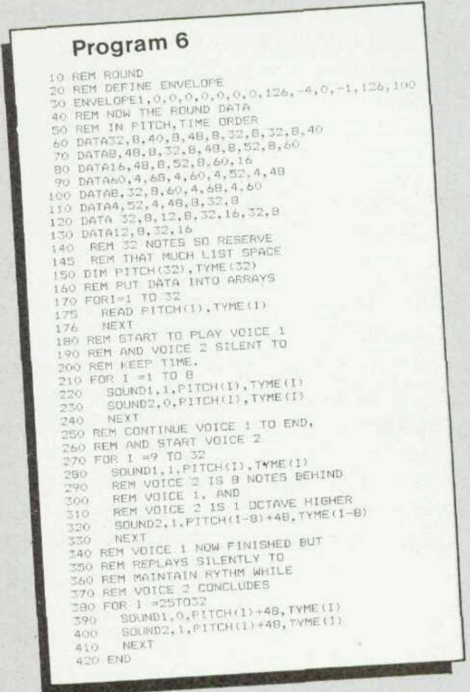
Figure 3. Play notes on these keys with Shift lock LED lit.



command, and matched by 1 to 4 in the volume section of the SOUND command.

Look at figure 4. This is an amplitude waveform common to the BBC ENVELOPE statement. It consists of 4 ranges marked attack (AA), decay (AD), sustain (AS), and release (AR), as well as two set points (ALA) -volume after attack ramp and ALD, -volume after decay ramp. The volume levels ALA and ALD are numbers between 0 and 126. To produce a useful envelope consideration has to be given to the type of instrument to be imitated. Look at figure 5 which is the amplitude envelope of a percussive piano-like instrument. Note the steep gradient of the attack ramp – giving the note bite, and the gentler slope of the decay, sustain, and release ramps, giving the fading sound of a piano note. The command to produce this is:

ENVELOPE 1, 0, 0, 0, 0, 0, 0, 0, 126, -4, 0, -1, 126, 100



Program 6

```
10 REM ROUND
20 REM DEFINE ENVELOPE
30 ENVELOPE1,0,0,0,0,0,0,0,126,-4,0,-1,126,100
40 REM NOW THE ROUND DATA
50 REM IN PITCH,TIME ORDER
60 DATA32,8,40,8,48,8,32,8,32,8,40
70 DATA8,48,8,32,8,48,8,52,8,60
80 DATA16,48,8,52,8,60,16
90 DATA60,4,68,4,60,4,52,4,48
100 DATA8,32,8,60,4,68,4,60
110 DATA4,52,4,48,8,32,8
120 DATA 32,8,12,8,32,16,32,8
130 DATA12,8,32,16
140  REM 32 NOTES SO RESERVE
145  REM THAT MUCH LIST SPACE
150 DIM PITCH(32),TYME(32)
160 REM PUT DATA INTO ARRAYS
170 FORI=1 TO 32
175   READ PITCH(I),TYME(I)
176   NEXT
180 REM START TO PLAY VOICE 1
190 REM AND VOICE 2 SILENT TO
200 REM KEEP TIME.
210 FOR I =1 TO 8
220   SOUND1,1,PITCH(I),TYME(I)
230   SOUND2,0,PITCH(I),TYME(I)
240   NEXT
250 REM CONTINUE VOICE 1 TO END,
260 REM AND START VOICE 2
270 FOR I =9 TO 32
280   SOUND1,1,PITCH(I),TYME(I)
290   REM VOICE 2 IS 8 NOTES BEHIND
300   REM VOICE 1, AND
310   REM VOICE 2 IS 1 OCTAVE HIGHER
320   SOUND2,1,PITCH(I-8)+48,TYME(I-8)
330   NEXT
340 REM VOICE 1 NOW FINISHED BUT
350 REM REPLAYS SILENTLY TO
360 REM MAINTAIN RYTHM WHILE
370 REM VOICE 2 CONCLUDES
380 FOR I =25TO32
390   SOUND1,0,PITCH(I)+48,TYME(I)
400   SOUND2,1,PITCH(I)+48,TYME(I)
410   NEXT
420 END
```

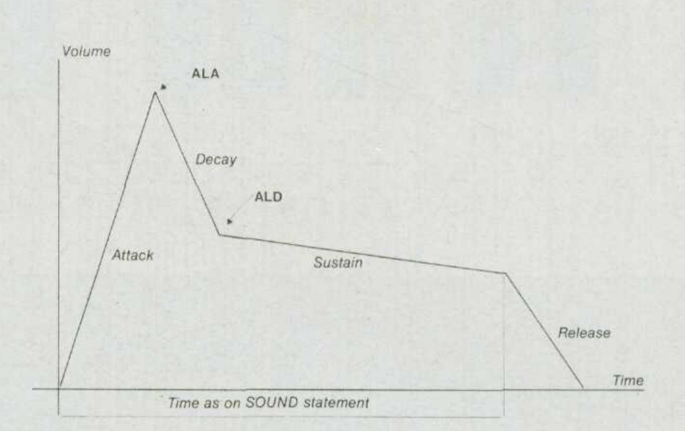


Figure 4. Amplitude waveform common to ENVELOPE statement.

The first parameter N, is 1, the envelope number. The second parameter T, is the time per step in 1/100s. (Plus an extra 1/100s. In this case 0 = 1/100s.) The next six zeros would be the pitch envelope. The next number, 126, is parameter AA. Combined with the parameter T and volume level ALA we create an attack ramp which increases at a volume (AA) of 126 per 1/100s (T) up to a maximum of 126 (ALA).

The next parameter is AD, the decay rate. The combination of parameters around this is T, AD, and ALD (the last parameter, 100). The decay ramp decreases to 100 (ALD) at a volume rate of -4 (AD) per 1/100th sec (T). The note then is sustained at that level (AS=O) until the time set in the sound statement runs out. The note then releases at a volume rate of -1 per 1/100s (T), and ceases sounding.

If further notes follow an envelope-controlled note, the release stage is cancelled. The next note starts immediately after the preceeding one has been held for the time set in its SOUND command. I'll let you consider figure 6, which is a totally different envelope, reminiscent of an accordian or mouth-organ. It is generated by the statement:

ENVELOPE 2, 1, 0, 0, 0, 0, 0, 0, 60, 10, 0, -60, 60, 120

Using the programs developed in this article, experiment with the amplitude envelopes. Enter them as low-numbered line numbers and alter the volume parameter of each sound statement to indicate the envelope waveform required.

The next stage is to move on to designing your own amplitude envelopes. The only warning is to keep off the six pitch parameters until you know what you are doing. Beware also, an envelope with AS and AR parameters set to 0, can sound permanently. To prove this micro is the beeb's knees, I include program 6 which uses the ENVELOPE and SOUND statements to play a round. Here, two voices play the same tune starting at slightly different times. The program is well REM'd so should not be too difficult to follow.

Next issue: pitch envelope and moving graphics.

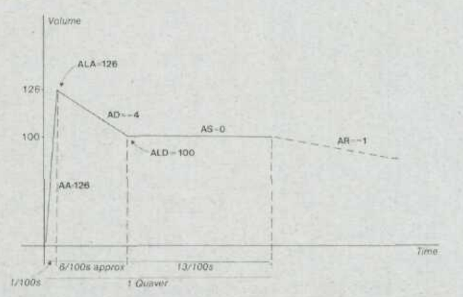


Figure 5. Percussive amplitude envelope given by ENVELOPE 1, 0, 0, 0, 0, 0,0, 0, 126,-4, 0,-1, 126, 100.

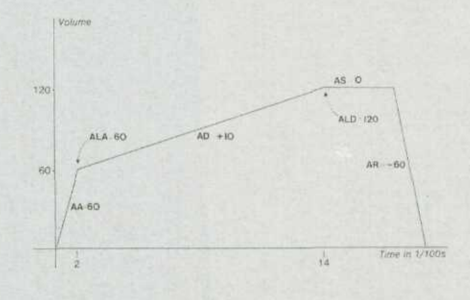


Figure 6. Reeded amplitude envelope given by ENVELOPE 2, 1, 0, 0, 0, 0, 0, 0, 60, 10, 0,-60, 60, 120.

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SPOOL, EXEC AND VERIFY - JUST FOR THE RECORD

The disc pack manual does not tell all about these useful features

The Atom disk pack provides several capabilities which were not documented in the initial disk pack manual. These include the ability to keep a record of all information printed to the screen on the disk, and to store on the disk a set of commands which can then be obeyed as if they were typed in at the keyboard. Also not mentioned was a VERIFY command which is documented here. The last undocumented feature is the software to drive the Acorn 40-character VDU card from the Atom.

The command *SPOOL "name" opens a file of the given name and all characters subsequently printed to the VDU system are also stored in this file using ASCII. The spooling of characters to a file is stopped by using the *SHUT command. Examples will probably make this clearer.

Characters can appear on the screen in several ways:

- as a result of a print statement in a Basic program.
- when a character is typed at the keyboard.
- as a result of some command in Basic or the operating system (eg, LIST or *CAT).

All these characters will end up in the spool file if one is opened. One important point is that the carriage return and line feed codes sent to the screen at the end of each line of a Basic listing will also end up on the spool file. For example,

```
10  *SPOOL "Example"
20  PRINT "1234567890"
30  *SHUT
40  END
```

will create a file containing the following bytes in hex: 31 32 33 34 35 36 37 38 39 30, whereas the sequence:

```
>*SPOOL "Program"
>LIST
  10 *SPOOL "Example"
  20 PRINT "1234567890"
  30 *SHUT
  40 END
>*SHUT
```

will create a file with the ASCII codes for the Basic prompt and the characters LIST followed by the bytes OA and OD which are the codes for line-feed and carriage return. Next in the file will be the codes for the next line which consists of some spaces followed by characters 1 and 0, a space and so on until the line-feed and carriage return at the end of this line. This continues including the codes, for SHU and T and a final line-feed before the spool file is closed.

Contents of a spool file can be examined or printed to the printer by a program such as:

```
 5 P.$2
10 A = FIN "Program"
20 DO
30 P. $BGET A
40 UNTIL PIRA = EXTA
50 P.$3
60 END
```

Hence a record can be made of the output from the computer for subsequent printing, or examination by another program.

The *EXEC "name" command is a complimentary utility to SPOOL which gets bytes from a serial file on disk and enters them to the computer as if they had been typed at the keyboard. Hence doing an EXEC on the file "Example" created as in the description of spool would go as follows:

```
*EXEC "Example"
1234567890
```

and because there was no carriage return stored in the spool file, you would have to hit return to get the prompt back.

A sequence of common commands can be stored as a file to be EXECed.

```
*LOAD "Data" 8200
?18 = #28
LOAD "Program"
RUN
```

To type this in every time would be tedious, so an EXEC file could be created using the following program.

```
10 A = FIN "Start"
20 SPUT A, "*LOAD""Data""8200"
30 SPUT A, "?18 = #28"
40 SPUT A, "LOAD""Program"""
50 SPUT A, "RUN"
60 SHUT A
70 END
```

After this has been done, the program can be started by typing the *EXEC START command.

Another use of the EXEC file is to merge Basic programs.

A program similar to the one above could be used to create a file containing a few lines of Basic including line numbers and when the file was EXECed, the lines would be added to any Basic programs already in the current text space. If line numbers are duplicated, the lines in the EXEC file overwrite the lines in the program, so care must be taken.

Program 1

```
1 REM***************************
2 REM (C) ACORN COMPUTERS (1982)
3 REM***************************
5 REM NO RECOMENDATION IS GIVEN
6  REM OR IMPLIED AS THE USE OF
7 REM ANY OF THE ROUTINES USED
8 REM IN THIS PROGRAM FOR ANY
9 REM OTHER  PURPOSE
10 $TOP="P.'""ERROR IN CATALOGUE SECTOR 1 OR 2"";END"
12 ?16=TOP;?17=TOP/256;*CAT
13 @=5
15 M=#FFFF;U=#9C
20 L=#2000;H=#2100
30 N=H?5
32 P.'"NUMBER OF ENTRIES"N/8
35 P.'
45 P.'
50 S=(H?6&15)*256+H?7
55 P."SECTORS" S'
56 P.'"NAME   STRT EXEC LENGTH SSEC SEC"
60 E=N
65 F=2
70 d
75  B=H!E&M;Q=H!(E+2)&M;W=H!(E+4)&M+(H?(E+6)/16)*M
80 T=(H?(E+6)&15)*256+H?(E+7)
85 R=W/256;IFW&255<>0;R=R+1
90 IFF<T;P."BLANK              "F T-F;A=F;C=T-1;X=100;G.r
100 IFE=0;END
110 FOR O=0TO6
120 P.$(O?(L+E));N.
125 P. &B,&Q,&W,T,R
126  A=T ;C=T+R-1
127 IF R=0;G.190
130 X=190;G.r
190  E=E-8
200  IFE>=0;G.d
300 END
1130 rF=A
1135 LINK#E75B
1140  !U=#A000
1150  U?4=0;U?5=1;U?6=F/256;U?7=F
1153  P.$21
1155 $TOP="G.s"
1156 Y=!16;?16=TOP;?17=TOP/256
1157 REMLINK #E567
```

An alternative method of creating an EXEC file for a routine is to spool a copy of the required routine. If we have a program with a routine between lines 2000 and 3000 that we want to use:

```
>*SPOOL "Section"
>LIST 2000, 3000
 2000 - - -
 - - - - -
 - - - - -
 2900 - - -
> *SHUT
```

The file created will contain the >LIST and > *SHUT lines which will cause errors when the file is EXECed in, but this will not be a problem. The file however, also contains line-feed characters which must be removed. The following program will create a new file called ROUTINE with the line-feeds removed.

```
 10 A = FIN "Section"
 20 B = FOUT "Routine"
 30 E = O
 40 DO
 50 D = BGET A
 60 IF D = 13; IF E = 10;
    PTRB = PTRB-1
 70 BPUT B,D
 80 E = D
 90 UNTIL PIRA > = EXTA
100 SHUT A
110 SHUT B
120 END
```

It is then possible to use the EXEC command to add this routine to your programs..

Another command can be used to redirect all screen output to a set of routines in the disk pack which drives the Acorn 40-character Prestel character set VDU. This card from Acorn can be connected inside this Atom with a suitable power supply and will provide a 40 character by 25 line screen display on a colour monitor. Further details can be found in the Acorn Computer Systems brochure. Output will be sent to the 40 character VDU following *VDU 1 and to the normal Acorn screen following *VDU 0.

The verify utility (program 1) is written in Basic to run on the Atom in conjunction with the Atom disk pack. The program will attempt to verify all the sectors on a disk inserted in the drive indicating which files any corrupted sectors are in. The disk to be verified should be inserted in the drive before the program is run.

The program will first attempt to load the catalogue of the disk. This is stored on the disk in two sectors on track zero nearest the edge of the disk. If there are any errors in either of these two sectors, the rest of the verify program cannot operate and the program will report the fact and stop. Assuming the catalogue has loaded correctly, the program will then report.

The number of sectors on a disc should be 400. A disk formatted for eighty tracks will have 800 sectors and will not work in the standard Atom disk pack, though it is still possible to read the catalogue off an eighty-track disk.

The program will then, for each program saved on the disk, print:

- file name,
- start address in memory where the file would be located to
- execution address of the file,
- length of the file in bytes,
- location of the first sector of the file on the disk,
- number of sectors on the disk occupied by the file.

A row of dots should be printed below every file name. Each dot represents a sector of the file that has been verified. Any stars printed indicate sectors that cannot be loaded or verified. Any areas of the disk not allocated to files will be reported as blank and verified in the same manner, in particular you will normally find a large blank area after the last file on the disk.

If you do not wish to verify the whole disk, the escape key may be used. However, as the screen is disabled at certain points in the program, control F should be used after pressing the escape key to re-enable the screen. The correct sequence to escape is therefore ESCAPE, control F, RETURN, the error message can be ignored. The result on the screen is a clear visual indication of the size of files and blank areas on the disk, and corrupted sectors.



BBC BASIC FOR THE ATOM

Acornsoft's 20k BBC ROM conversion module can be added to an Atom, which will support the full set of BBC-type Basic commands. The syntax is identical, so all programs that don't rely on BBC hardware can be run on the Atom.

The module is fitted in parallel with Atom Basic and may be selected by a switch or from the keyboard with modifications. It consists of 16k Basic ROM, a 4k operating system ROM and an additional 2k RAM that can be used by the Atom as well. A comprehensive manual is supplied giving operating and fitting instructions.

The conversion board uses the same 16k Basic ROM as the BBC micro. The board includes a 4k MOS ROM to provide the correct machine environment on the Atom. The board also includes logic to alter the memory map so that RAM is available from 0000 upwards, and so that the 16k Basic ROM can reside at 8000 to C000.

The BBC-Basic time function is implemented by means of interrupts, generated by the Atom's 6522 timer (which must therefore be fitted).

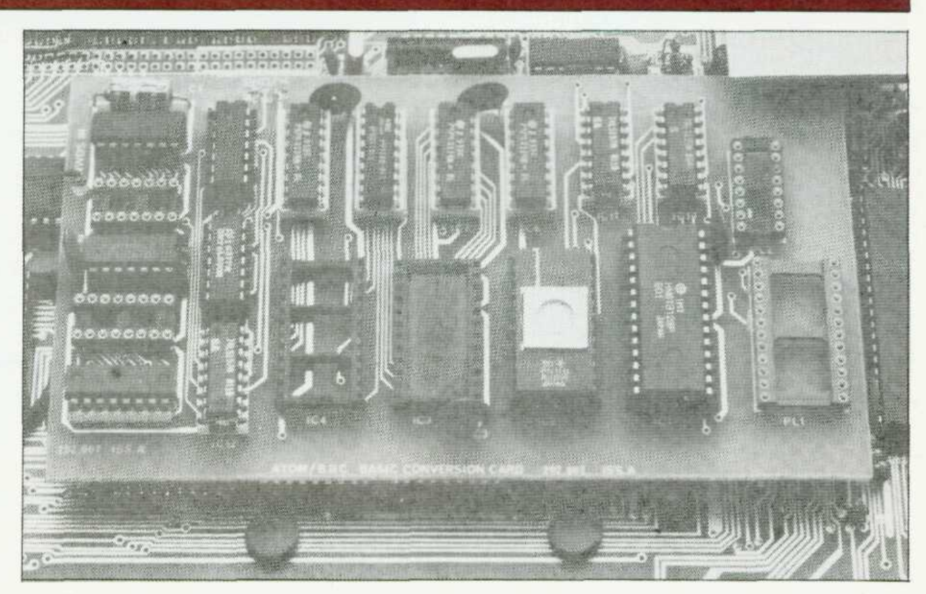
The BBC board is fitted by removing four integrated circuits from the Atom and inserting these in sockets on the board. The board is then plugged into the empty sockets on the Atom.

The BBC Basic board includes 16k Basic ROM, 4k MOS ROM, 2k of additional RAM, socket for utility ROM, socket for MOS extension ROM, decoding logic.

The board can either be wired permanently in BBC-type Basic mode, or, with the addition of two wires to the Atom keyboard, you can select between Atom or BBC-type Basic by pressing CIRL-BREAK or SHIFT - BREAK respectively. Alternatively, the module can be fitted by your dealer.

The commands MOVE, DRAW, and PLOT are supported, with drawing of lines or points, relative or absolute, and drawing in white, black or inverted. The facilities for area fill and dotted lines are not supported.

The board allows users to type in BBC programs, but cassettes cannot be loaded. It costs £49.95.



BBC Basic board fitted inside the Atom

Memory map for conversion

Address	Atom mode	BBC-type mode
FFFF–F000	Atom ROM	MOS ROM
F000–E000	Optional DOS	Optional DOS
E000–D000	Extension ROM	Extension ROM
D000–C000	Atom ROM	Optional MOS
C000–B000	I/O	BBC Basic
B000–A000	Utility ROM	BBC Basic
A000–9800	(hatched)	BBC Basic
9800–8000	Graphics RAM	BBC Basic
8000–7000	(hatched)	I/O
7000–6000	(hatched)	Utility ROM
6000–5800	(hatched)	(hatched)
5800–4000	(hatched)	Graphics RAM
4000–3000	(hatched)	Optional RAM
3000–2000		Optional RAM
2000–0400		RAM
0400–0000	RAM	RAM

The chip that made a name for itself

There's no smoke without fire and although computer magazines make little of the issue (right), Sinclair does seem to have been hit by the same problem that delayed the BBC micros – faulty ULAs. But how can one chip cause such a fuss? Acorn director Andy Hopper explains the tricky aspects of uncommitted logic arrays in system design.



technical
who has started the rumo
that Sinclair has run into the
same ULA problems which
have dogged the BBC Com-
puter? Do we sense dirty
deeds afoot? Fact is, there
was a technical problem with
the Spectrum which involved
the first batch of machines
being sent back to the Timex
factory at Dundee and this,
coupled with a short strike
there, delayed initial deliveries
somewhat. But production is
in full swing and was in fact
recently witnessed by Editor
Rodwell in person when
'Uncle' Clive flew a select
group of micro-hacks to
Dundee in the Sinclair plane
(a twin-engined, turbo-prop
Cessna Corsair – nice, but
without the gold-plated
fittings which Jack Trameil
has in his jet). And 'Rodders'
has at last received his
Spectrum, so they *are* being
delivered. And it works, so
discount any ULA rumours
you might hear . . . Still on
Spectrums, hilarious news

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In designing an Acorn computer we consider the system both from hardware and software points of view. But between these two is a grey area where functions can be implemented by either. Often the specification of a computer can be enhanced by implementing complex low level software functions in hardware. To do this we need to design hardware rapidly and cheaply.

This can be done if we design chips specifically for the application, as off-the-shelf components often provide features we do not require.

There are exceptions: chips such as microprocessors and memories are standard parts which can be manufactured in volume to cut costs. Specially designed chips can also be used to 'mop up' the board and keep the number of components to a minimum.

There are many ways of designing and manufacturing a semiconductor chip. At one extreme there is the fully custom approach where all steps in the manufacturing process are specified by the designer. Each transistor, resistor and chip component is of the right size and type to perform its function. At the other end, programmable logic arrays (PLAs) have been designed which perform complex combinatorial functions but have no memory, and so can only be used to implement restricted system functions.

Between these there are uncomitted logic arrays (ULAs). These are chips where most of the design work is already done and components have predetermined values and sizes. Furthermore, these basic building blocks are in fixed places on the chip. Normally this is done on a grid with components grouped into cells, which are then arranged in rows across the chip. To commit the chip, or customise it to a design, the designer has to specify how these building blocks are connected. Normally this is done by a small number of easy manufacturing steps so the chips can be made cheaply.

There are many ULAs designed in both bipolar and MOS technologies and in sizes ranging from 100 to 8000 gates. Customisation is carried out by depositing either a single or double interconnecting layer of metal on the surface of the chip. In some ULAs, the metal connects resistors and transistors which are used to form gates, in other systems the gates have already been manufactured and the customising is done at a higher level.

Depending on the application the ULA works at a speed at which it can communicate with the neighbouring logic. The fastest ULAs have switching speeds of less than one nanosecond per gate. Then there are systems which switch at tens or hundreds of nanoseconds per gate, but consume less power. Hence a larger number of gates can be houses in one package without the need for special cooling.

To make ULAs versatile it is



possible to specify the voltages on the pins used to communicate with other chips. Thus it is easy to mix MOS, TTL and ECL logic or use any other system. This is normally possible because around the outside of the ULA there are peripheral cells which contain components used to implement pin driving functions. In some cases it may be possible to perform simple analoguefunctions in this way.

To design a ULA it is necessary to know the rules for implementing logical functions. The ULA concept restricts the way components can be connected but this has the advantage that it prevents mistakes. The rules are simple and specify the maximum fan-in and fan-out of a gate and may prohibit some unusual forms of asynchronous logic. To design the chip it is also important to take into account the propagation delay of each gate and how this varies with the way it is connected to others, with termperature and with production tolerances.

Once equipped with the design rules it is possible to specify how ULAs are to be committed. This can be done either by designing in some other logic system – such as TTL – and converting to the chip design, or by designing directly in the logic system of the ULA. The former approach has the advantage that it is possible to build an emulation easily. The latter allows gates to be used only as required and it is possible to take advantage of ULA features to design systems which would otherwise be impossible with discrete logic. There is an example of this kind of flexibility in the BBC machine's video processor.

In this we have used a palette memory which provides some of the sophisticated graphics features. The memory is dual-ported so it can be addressed in two ways, one for up-dating and the other for reading contents. This would take many more components if it were done externally in discrete logic.

When the logic design is complete the likelihood of



ULA casing hides 8000 gates

successfully computing the physical interconnection structure of the ULA is estimated. To do this, the gates in the system are counted. Clearly this must be less than the total number of gates available for connection. However, if the design is complex, it may be difficult to use each gate without blocking-off or encircling others. Thus it may take great skill to use more than three-quarters of the available components. However, as the chip price is not very dependent on the number of components used, there is always pressure to use as many gates as

'Some faults only appear in extreme conditions'

possible. All Acorn ULAs have used 95% or more of the available components.

When designing the ULA it may be possible to implement analogue as well as digital functions, but this is only possible with ULA systems where individual transistors and resistors are available for interconnection. An analogue circuit on the BBC machine serial processor can approximate a sine wave used for storing data on cassettes. This interface performs well because the ULA allows a high quality approximation to be provided cheaply.

Although ULAs can be designed using hand techniques, as the number of gates increases software tools have to be provided. These fall into two categories: simulators which predict the behaviour of the chip before manufacture and layout, and layout and verification programs which take the simulated design and implement it on a ULA.

Therefore a complex design is begun by simulating the logic. To do this the design is specified using either graphical input or a se. Once the design has been described it can be simulated by providing input waveforms. The outputs are then checked until the design is satisfactory. To convert this to a physical chip the gates are placed on the surface of the ULA (or allocated to uncommitted components) and then connected together.

Although programs exist to do this automatically, complex designs require manual intervention. Because the simulator only uses assumptions about the location of gates and because hand intervention may have introduced errors, it is crucial to be able to simulate the chip using the physical implementation as the model. Only once this has been done and the results are satisfactory is the information passed to a manufacturer who makes the chips. If the tools are of high quality the chip will perform exactly as the simulator predicts and work first time.

Manufacturing steps are fairly simple – but they take time. If a fault is found it can take months for it to be corrected. In particular, if the design assumes everything will work and does not provide facilities for tracing faults, debugging may be a severe problem. Also it is easy to try to use more components than can be utilised on a chip. The design may work with small variations in production tolerances but may fail if these change substantially. Some faults may only become apparent at extreme operating conditions. Everybody has heard about the BBC machine ULA problem. This was caused by a fault which did not show in samples but was present in later chips. Although it was quickly traced and corrected, the delay in production almost made ULAs a household word.

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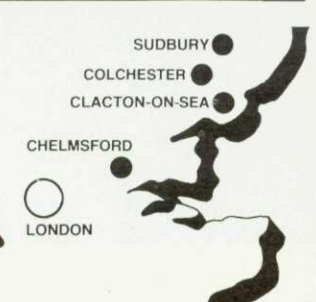
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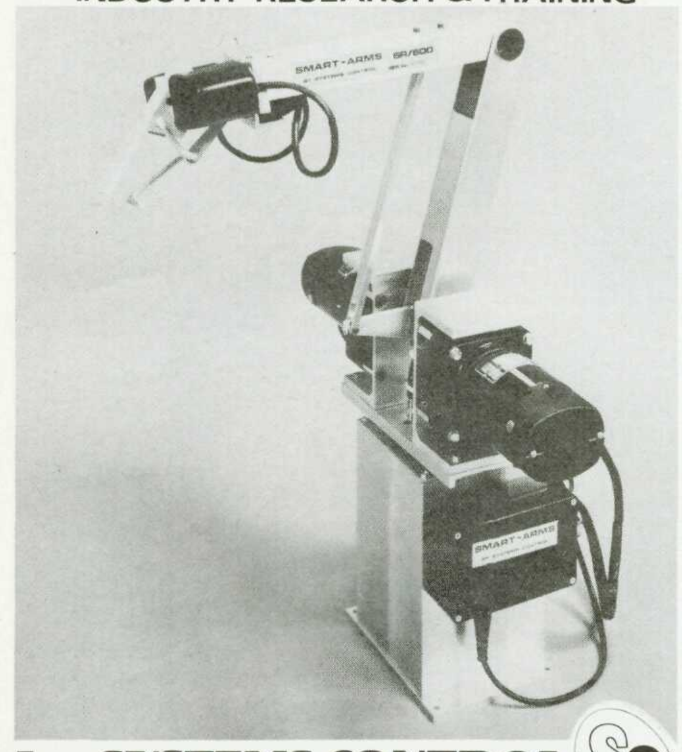
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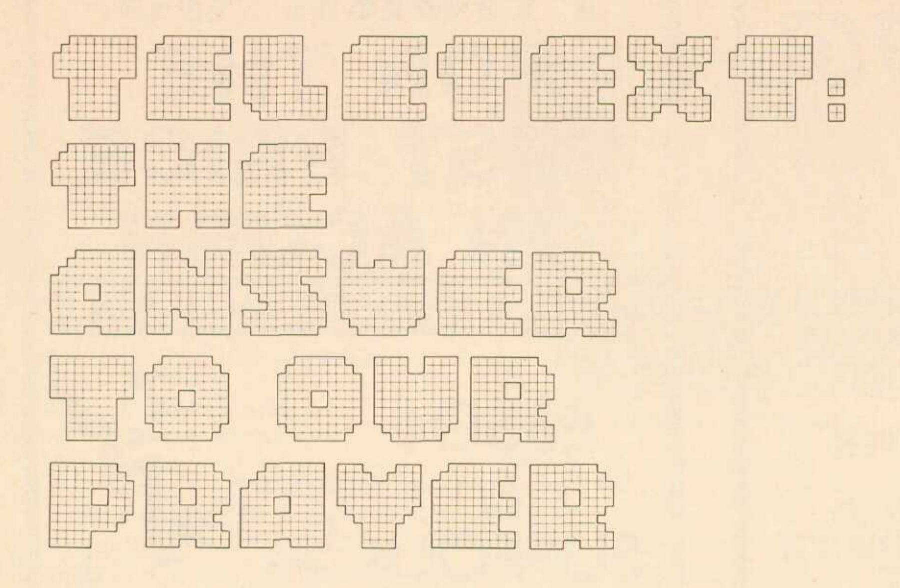
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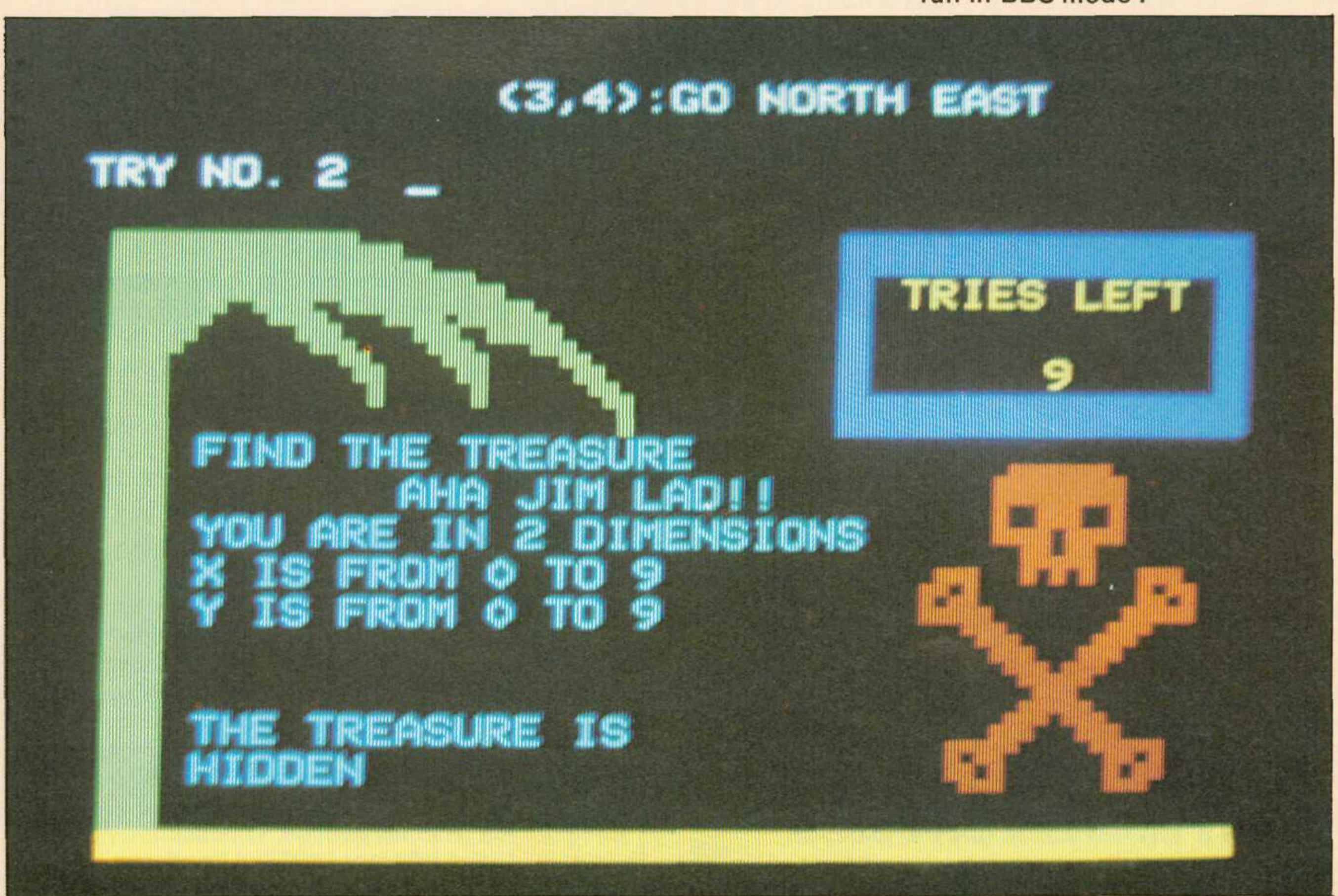
Paul Carpenter and Graham Field of the ITMA project explain how they write programs using teletext graphics

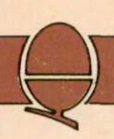
Converting programs to run on the BBC Machines has presented the ITMA project with a major problem. Software has been written for the Research Machine, 380Z microcomputer and although programs convert relatively easily, there is not enough memory on the model A to use any of the graphics modes and have the program in memory. Even using the model B has proved impossible with some longer programs. But the flexible graphics of the BBC machine provided an answer – write programs using Mode 7 in teletext graphics characters (see below).

Although mode 7 is not precise enough for accurate scientific representation, or measurement, it can provide perfectly adequate displays for educational programs when used with care.

The teletext character set consists of two sequences, which we will call

Pirates. . . just one of the programs ITMA has converted to run in BBC mode 7





the alphabetic sequence and the graphics sequence. The former consists of standard ASC11 characters 32-127, display control codes 128-159, and the ASCII characters 32-127 repeated from 160-255. The latter has the same control characters from 1 - 31, the same display control characters from 128 - 159 and the upper-case letters together with a few other characters repeated twice between 64-95 and 192-223. The graphics themselves consist of six small squares forming a 3x2 grid for which the code may be calculated from the scheme in figure 1, to which should be added an offset of 160.

The alphabetic sequence is selected by writing an alpha control character, and the graphics sequence by writing a graphic control character (see figure 2) on the current line to the left of the character to be displayed.

Two things must be remembered about the display control characters. Each effects the remainder of the line it is on (until changed by another control character) and each occupies one character position on the screen. Thus:

```
PRINT TAB (5); CHR$136;
CHR$132;"*"
```

will display a flashing (CHR$136), blue (CHR$132), star at the *seventh* position on the line.

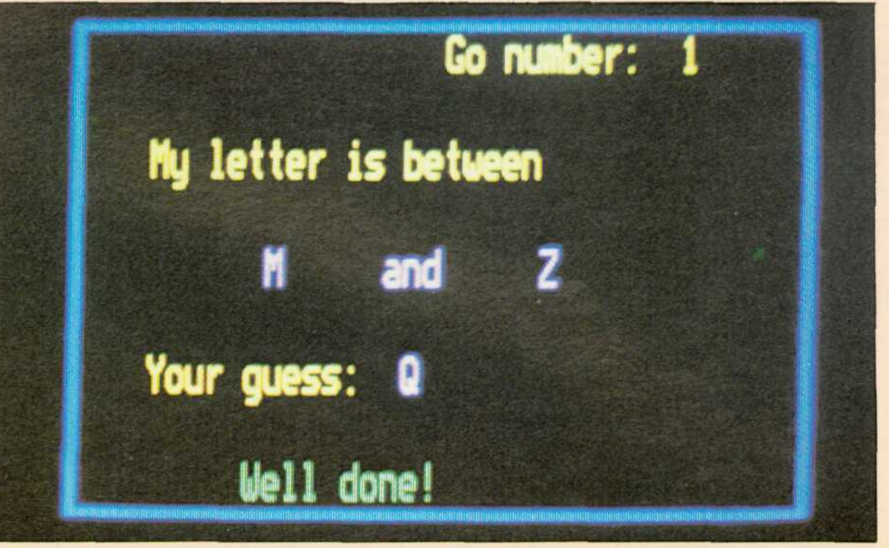
To change background, first decide, and set, a colour, change to a new background (which will be in that colour) and then choose and set a character colour. Thus:

```
PRINT CHR$131;CHR$157;CHR$148;
```

will display, on the remainder of the line, blue graphics characters (CHR$148) on a yellow (CHR$131) background (CHR$157).

To view the mode 7 graphic character set, run the following program:

```
10 MODE 7
20 FOR J=32 TO 126
30 PRINT J:CHR$151,CHR$I
40 Z=INKEY (20)
50 NEXT
60 FOR J=160 TO 254
70 PRINT J:CHR$151,CHR$I
80 Z=INKEY (20)
90 NEXT
```



BIGALF. . . an introduction to the alphabet which uses screen colour techniques described below

Note that CHR$151 on lines 30 and 70 defines white graphics. For a different colour, change the 151 to the appropriate code, for example 146 changes the colour to green. The following example shows how to colour the whole screen yellow and print the word FRED in red, double height characters:

```
10 MODE 7
20 REM COLOUR SCREEN
30 FOR J=0 TO 24
40 PRINT CHR$147,CHR$157;
   CHR$129
50 NEXT
60 REM PRINT DOUBLE HEIGHT
70 PRINT TAB (20,10);CHR$141;
   "FRED"
80 PRINT TAB (20,11);CHR$141;
   "FRED"
90 END
```

This facility is used in the program

. . . 46 ▶

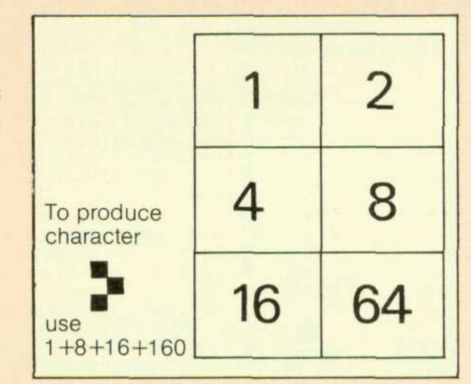


Figure 1. Six squares make up a graphics grid used to build up characters

Display control characters

129 Alpha red
130 Alpha green
131 Alpha yellow
132 Alpha blue
133 Alpha magenta
134 Alpha cyan
135 Alpha white
136 Flash
137 Steady
140 Normal height
141 Double height
145 Graphic red
146 Graphic green
147 Graphic yellow
148 Graphic blue
149 Graphic magenta
150 Graphic cyan
151 Graphic white
152 Conceal display
153 Continuous graphics
154 Separated graphics
156 Black background
157 New background

Figure 2. The graphics sequence is controlled by these characters, each of which effects the remainder of the line it is on, until changed by another character



Wordworm. . . spelling program

BIGALF which was designed as an introduction to the alphabet for young children.

Routines to plot individual squares are shown in Figure 3. To use them, clear the screen and put the appropriate graphics controls down the left-hand side of the screen. Do any display of (upper-case) characters using PRINT TAB (x,y); where y is always less than 24. *Do not allow the screen to scroll.*

We have found the Basic interpreter fast enought to cope with moving displays using these routines, as in our spelling program, Wordworm above in which a 'worm' is steered by the user to eat the letters of a word.

The ITMA Project – Investigations on Teaching using Microcomputers as an Aid – provides a back-up for teachers. Details from: The Secretary, ITMA Project, College of St Mark and St John, Derriford Road, Plymouth, Devon PL6 8BH.

Figure 3. Listing to plot individual squares

```
10 REM  GRAPHICS ROUTINES
20 REM
30 REM X% runs from 0 to 79 across the screen
40 REM Y% runs from 0 to 69 down the screen
50 FEM
60 REM Include this function in all programs
100 DEF FNmask(A%,D%)=4^D%*2^A% - 32*(A%*D%=2)
110 REM
120 REM Test location X%.Y%. Return ASCII code if letter.
130 REM 0 if empty, 1 if set, 2 for a control character.
500 DEF FNtest(X%,Y%)
510 LOCAL A%,D%,A1%,D1%,P%
520 PROCpickout(X%.Y%)
530 IF(P%)63 AND P%(96) OR (P%)191 AND P%(224) THEN 580
540 IF (P%(32) OR (P%)126 AND P%(160) THEN P%=2:GOTO 580
550 IF P%(127 THEN P%=P%-32 ELSE P%=P%-160
560 P%=-((P% AND FNmask(A1%.D1%)) ) 0)
580 =P%
590 REM
595 REM Allocate character position to coordinates X%, Y%.
600 DEF PROCpickout(X%,Y%)
610 A% = X% DIV 2: A1% = X% MOD 2
620 D% = Y% DIV 3: D1% = Y% MOD 3
630 P% = ?(HIMEM + D%*40 + A%)
640 IF(P%)31 AND P%(64) OR (P%)95 AND P%(127) THEN P%=P%+128
650 ENDPROC
660 REM
670 REM Plot at X%, Y%
680 REM C%)1  -  A graphics character or letter
690 REM C%=1  -  A small square in the foreground colour
695 REM C%=0  -  A small square in the background colour
700 DEF PROCplot(X%,Y%,C%)
710 PROCpickout(X%,y%)
720 IF C%)1 THEN P%=C%:GOTO740
730 P%=P%-(P% AND FNmask(A1%,D1%)) + C%*FNmask(A1%,D1%)
740 PRINT TAB(A%,D%);CHRS(P%)
750 ENDPROC
```

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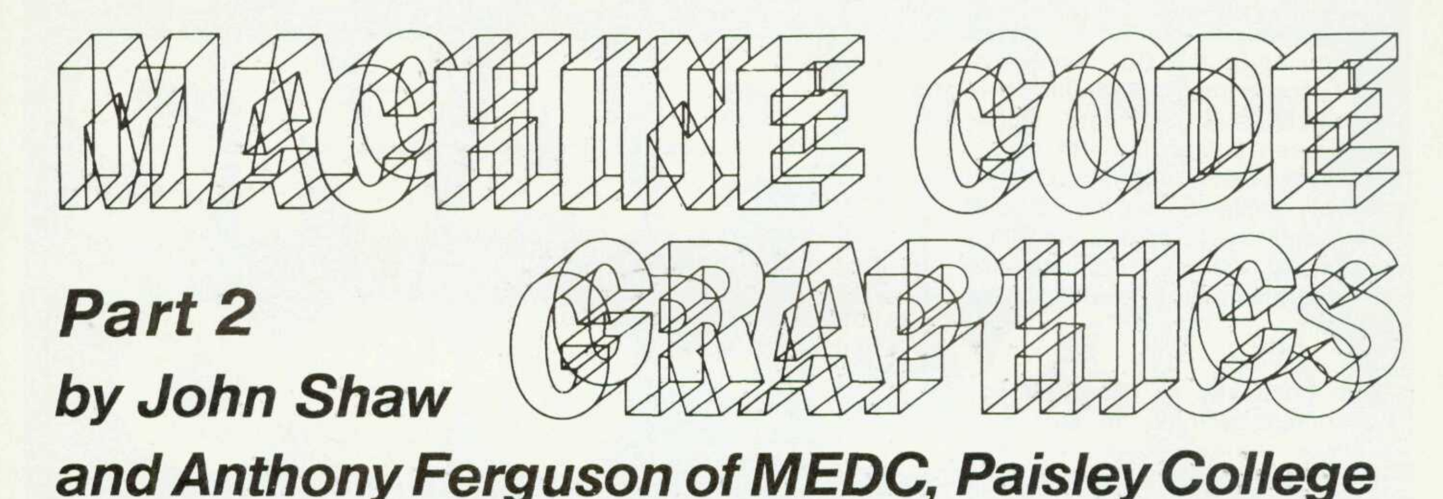
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Part 2

by John Shaw

and Anthony Ferguson of MEDC, Paisley College

Functions can easily be driven from an assembly language program. This follows from the design of the BBC's design of the BBC's display software which is 'code driven' and aimed at an intended future role of the machine – namely a sophisticated graphics terminal to a second language processor, 6502, Z80 or a 16-bit option, with its own memory.

The varied nature of graphics programs makes it difficult to standardise an approach to how VDU commands might readily be translated to a series of assembly language statements.

As each command is accurately defined by a series of data items, one possible way is to use a subroutine to send the series of data items to the machine operating system. For example:

VDU 25,0,0,0,0

is accurately defined by the data series

5,25,0,0,0,0

where the first number, 5, indicates the number of separate data items that follow and are to be sent to the machine operating system via subroutine OSASCI.

The subroutine in figure 1 will send any such series of data items to the machine operating system. It uses the first number in the series to determine how many times it must call the subroutine OSASCI and send a byte of data.

A pair of page 0 memory locations are used as a pointer to the appropriate data items to be output and the subroutine is called successively for each data item to be sent. The VDU command is stored as a series of parameters to be sent to the machine operating system via the subroutine and any change in the variables (e.g. *x, y* data pairs) to be sent can be made to the appropriate values in the data series. Two or more commands that regularly go together can be made into combined data series for faster execution.

This technique is illustrated in figure 2, a new version of the earlier somewhat lengthy program (*Acorn User*, July). This is only one possible approach to adopt and is not universally suitable for all assembly language programs.

Since changing the graphics colour is always followed by homing the cursor these commands have been combined

Figure 1

```
100 REM assembly language graphics
110 OSASCI=&FFE3
120 PNT=&70
125 DIM A 100
130 FOR PASS=0 TO 3 STEP 3
140 P%=A
150 REM subroutine to send string of
160 REM data bytes as VDU command
170 REM on entry PNT set to start of
180 REM required command string
190 [OPT PASS
200 .SEND  LDY #0        ;Y counts bytes
210        LDA (PNT),Y ;save string
220        STA PNT+2    ;length here
230 .NBYTE INY
240        LDA (PNT),Y ;send next
250        JSR OSASCI   ;byte
260        CPY PNT+2    ;finished?
270        BNE NBYTE
280        RTS
290 ]
300 NEXT PASS
310 END
```



into a single series of bytes. Unfortunately, the BBC assembler does not support a define byte statement and the data values have been placed into RAM from Basic at CCHC. Since CCHC+3 always contains the byte that represents the foreground graphics colour, its value in the data series is changed from within the program.

The command to draw the line horizontally across the screen is also a series comprising two commands that always go together. This series has been placed into RAM at DLIN. After assembly they can be run using the CALL command.

All versions of this program, including the Basic one, will produce far more interesting screen effects if, instead of changing the screen colour, the colour relationship parameter is changed.

In the Basic program this is the first parameter in the GCOL statement. The changes required are:

```
105 FOR Rel=0 TO 255
120 GCOL Rel, Colour
190 NEXT Rel
```

In the final assembly language program changing lines 450 and 460 to

```
450 INC CCHC+2 Inc colour relationship
460 LDA CCHC+2
```

The unique design of the display software on the BBC microcomputer gives the programmer easy access to all the graphics functions from a machine code program. Since Basic and machine code programs use the same graphics software, the latter does not necessarily lead to any significant speed advantage.

However, machine code programs should prove useful in allowing the programmer to build up a collection of routines that lie outside the Basic text area, loaded directly from tape or housed within the machine in EPROM. Such a library of routines would prove useful in expanding the graphics. For example, circle or arc drawing routines could be written that would be available for use from Basic or any other high level language option as required.

Figure 2

```
100 REM assembly language graphics
110 MODE 5
120 REM
130 REM placing the command data into RAM
140 DIM DLIN 200
150 REM draw lines command data
160 FOR J = DLIN TO DLIN+12
170 READ BYTE
180 ?J=BYTE
190 NEXT J
200 DATA 12,25,1,0,5,4,0,25,1,0,&FB,4,0
210 CCHC=DLIN+13
220 FOR J = CCHC TO CCHC+9
230 READ BYTE
240 ?J=BYTE
250 NEXT J
260 DATA 9,18,0,0,25,4,0,0,0,0
270 OSASCI=&FFE3
280 POINT=&70: REM page 0 location
290 FOR PASS=0 TO 3 STEP 3
300 P%=CCHC+10
310 [OPT PASS
320 .NCOL  LDA #CCHC MOD 256 ;set pointer to
330        STA POINT         ;CCHC data
340        LDA #CCHC DIV 256
350        STA POINT+1
360        JSR SEND
370        LDX #128
380        LDA #DLIN MOD 256 ;set pointer to
390        STA POINT         ;lines data
400        LDA #DLIN DIV 256
410        STA POINT+1
420 .NLIN  JSR SEND
430        DEX               ;dec line count
440        BNE NLIN           ;another line?
450        INC CCHC+3         ;inc colour
460        LDA CCHC+3
470        CMP #16            ;finished?
480        BNE NCOL
490        RTS                ;return to BASIC
500 ]
510 REM subroutine to send string of
520 REM data bytes as VDU command.
530 REM On entry POINT is set to start of
540 REM required command string
550 REM Note - corrupts Y reg
560 [OPT PASS
570 .SEND  LDY #0         ;set byte count
580        LDA(POINT),Y   ;save string
590        STA POINT+2    ;length here
600 .NBYTE INY
610        LDA (POINT),Y ;send next
620        JSR OSASCI     ;byte
630        CPY POINT+2    ;finished?
640        BNE NBYTE
650        RTS
660 ]
670 NEXT PASS
680 END
```

LOOK OUT! THERE'S A SNAPPER ABOUT



Flashing 'Power Pills' – after snapper has eaten them the ghosts turn blue.



Snapper makes eating noises as he snaps the ghosts, dots and fruit.



After the ghost has been 'snapped' their eyes return to the cave.



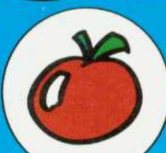
The ghosts eyes always look in the direction they are going.



Blue ghost ready for eating. If not eaten quickly they flash and revert back.



Fruits increase in value with higher scores.



Bonus points awarded for eating fruit.

Score: 38030

Snapper-the new addictive arcade-style game for the BBC micro from Acornsoft.

Snapper's food is fruit and he must eat to stay alive. Ghoulish ghosts try to gobble him up and he can't fight back until he has found and eaten a power pill.

A total of 1,000 points is the minimum to rank among the top eight players on the high-score table – but the highest known score is 127,000!

Snapper has amazing eight colour graphics with full sound effects and a high score ladder.

For full details of this and other exciting games for the BBC Microcomputer System ring 01-930 1614 or write to:

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Getting analogue data onto the screen with a BBC model B is easy. Ian Carpenter, a Cambridge science and microtechnology inspector shows you how. If you haven't got the upgraded model, don't worry – getting from A to B is as easy as . . .

ANALOGUE IN

Microcomputers are digital devices, they live in a world of 'on' and 'off' or 0s and 1s. But the world around us is not so black and white, so to connect the real world to a micro you need an analogue to digital converter (ADC). The model B is fitted with a converter available through the 'analogue in' connector. Don't despair if you only have a model A; about £10 and 15 minutes will sort that out.

Model A owners can easily add on the 'analogue in' facility. A 74LS00N chip fits in socket IC77, a D7002C ADC chip fits in socket IC73 leaving 10 minutes to solder a right angle 15 way 'Dee' socket onto the main board using the holes provided. If you are not happy doing this job yourself, have a word with your Acorn dealer.

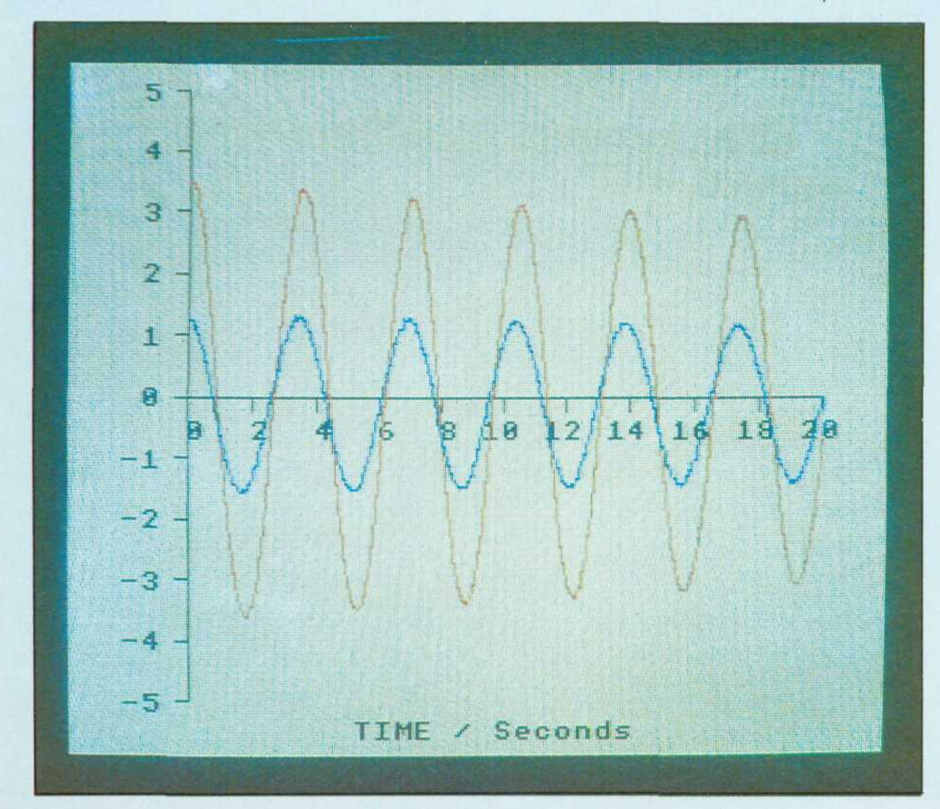
BBC Basic fetches the Analogue-Digital VALue from the ADC with the instruction ADVAL (1). There are four channels on the ADC chip so the number in brackets just selects which channel.

Type this into your computer:

P. ADVAL (2)

you will get a number, about 60,000 returned. Try it again, you should get another number at about 60,000. As we haven't connected anything to the 'analogue in' connector we are getting random numbers returned through ADVAL. Voltages of from 0 to 1.8 volt fed into the connector produce numbers in the range 0 to 65,520 (see *User Guide* for why). The easiest way of feeding this voltage in is to use a variable resistor or potentiometer connected beween 0 to 1.8. The computer gives us 0 and 1.8 on the 'analogue in' connector on pins 5 and 11 respectively and we can feed back our voltage on pin 15. (Note that Adval (1) refers to CH0, ADVAL (2) to CH1 etc on the diagram on page 223 of the provisional guide, note also error number 2,756! (Pin 14 is not CH1 it is VREF.)

Let's look at a program using ADVAL. Program 1 is called 'paint the adder' and draws a snake on the screen – you have to paint the stripes on his back using a potentiometer as a paint brush.



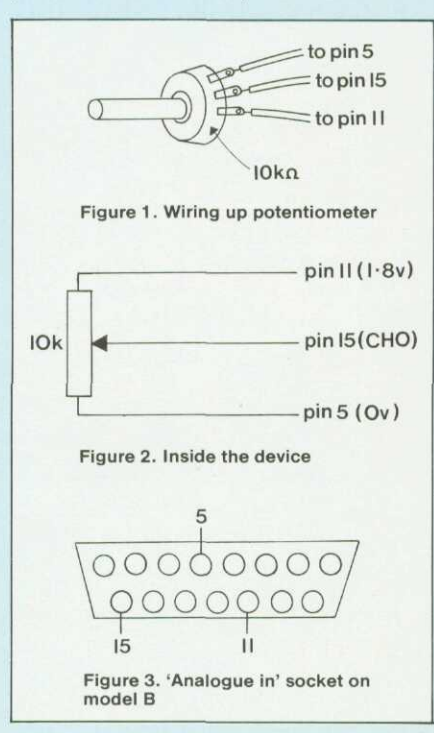


Figure 1. Wiring up potentiometer

Figure 2. Inside the device

Figure 3. 'Analogue in' socket on model B

Pendulum recording . . . same period, but different amplitude

Lines 10 and 20 clear the screen and select a graphics mode with text and graphics combined. Line 30 determines the *x* co-ordinate of the snakes head whilst line 40 determines the *y* co-ordinate. PROCBOX is a procedure defined in lines 150 to 160 which fills in a box on the screen at co-ordinates *x,y*.

Line 70 takes the value of ADVAL (1) and divides by 65 to make the number returned to be in the range 0 to 1000, so it fits on the graphics screen. Line 80 uses the value of V to print '>' on the back of the snake so our simple voltage divider potentiometer can move the arrow up and down the screen to leave the '>' on the adder's back (with practice!). Line 90 slows the snake down – if you get good you can reduce the 20 to a smaller number to suit your ability. Line 140 allows you to repeat the game by pressing the space bar.

The 'paint brush' or games paddle should be made from a 10kΩ potentiometer as shown in figures 1-3. The 10kΩ potentiometer should be 'linear' but a 'log' type could be more fun.

Any aspiring (or perspiring!) O-Level physics student could have a great deal of fun rearranging the potentiometer above with a piece of string and a small weight to get the arrows painted automatically on the snake's back. Fun maybe, but it does have a serious side because many of the measurements made in school laboratories could be fed into the BBC micro for processing and display.

Cambridgeshire Educational Computing has produced programs which allow pH, voltages, current, light level, wind speed, temperature, weight, mass and so on to be displayed in large digits, on an analogue scale or as a graph with respect to time. Automatic weather stations can be set up recording say temperature, sunshine, wind-speed and wind directions over a time span of a week or, as shown on the left, a recording over 20 seconds of the swing of a simple pendulum showing that the period is the same even though the amplitude is significantly different. Exponential decay of voltage across a capacitor can be displayed just as easily as a cooling curve. These areas will revolutionise science equipment over the next few years – manufacturers beware!

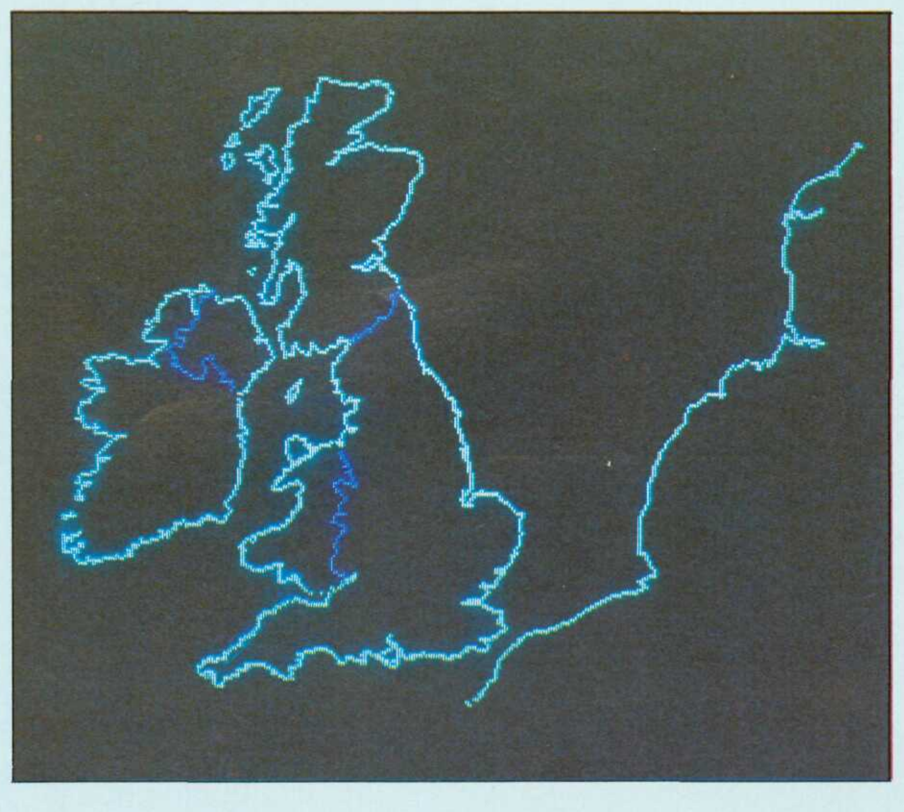
```
 10MODE 5
 20VDU5
 30FOR X=0 TO 1100 STEP 20
 40Y=450+250*COS(X/90)
 50PROCBOX
 60VDU26
 70V=ADVAL(1)/65
 80MOVE X,V:GCOL1,2:PRINT">"
 90Z=INKEY(20)
100NEXT
110VDU19,3,8,0,0,0
120SOUND 0,-15,4,30
130MOVE X+35,Y+50:GCOL0,3:PRINT"<"
140REPEAT UNTIL GET$=" ":GOTO 10
150DEF PROCBOX
160VDU24,X;Y;X+70;Y+70;
170GCOL1,129:CLG
180ENDPROC
```

Program 1. Draws snake on screen ready for colouring

Another interesting possibility using the 'analogue in' connector is the use of a cheap graphics tablet costing about £60 (one tenth the cost of any conventional tablet). The software developed for graphics tablets allows pictures to be rotated and distorted to your heart's content.

With a micro as good as the BBC machine we are in for some exciting times ahead.

Further details of software and hardware can be gained (sae please) from Cambridgeshire Educational Computing, Resource and Technology Centre, Back Hill, Ely, Cambs.



Britain. . . as seen on the screen via a graphics tablet

TEACHING TEACHERS

Pam Fiddy reviews the problems facing teachers who want to use micros

Primary teachers in their thousands are now showing an active interest in computing, and the advent of the BBC micro is expected to swell their numbers still further. We have the beginnings of computer studies (learning about computers) and computer-aided learning (learning with computers) two areas which often overlap. Teachers are learning how computers handle information in the world outside school, and discovering how computing could be used to help children handle information.

No one can claim to have all the answers about computing and primary education, but anyone with initiative, a microcomputer and an interest in education is well equipped to join the pioneers.

At first, teachers looked to a computer for help with work they were already doing. Many programs of the 'drill and practice' variety were written, which children find more attractive on a computer than with pencil and paper.

However, despite the claims, these programs do not teach, although they can test or practice what children have already learnt.

Far more exciting are programs that aim to extend learning. These may look more like play than work, but they offer opportunities for children to discuss ideas, think, try things out and learn from mistakes.

Computer awareness and confidence is something children can gain once a micro comes into a primary school, no matter what programs are on it. Children can see for themselves that computers are fast and interactive, and that information flows between the user and the computer. They develop a casual approach to the technology that is the envy of many adults.

In many schools this is taken further. At any age there is a certain satisfaction to be gained from understanding a program, knowing what the computer must do, and then imputting some information that will force it to make a fool of itself, or will outwit the programmer. Such experiences can help children develop a healthy relationship with the technology, and prove computers do not always know the answers, and are not better than people at 'getting things right'.

Children can be taught to program from an early age – though arguments rage as to whether they should do so. But the intention is not to turn everyone into programmers, it just reflects the fact that computers, like written words, are important in our lives.

Learning to use a microcomputer can be exasperating as well as exhilarating, but help is available from BBC micro user groups such as MAPE, the Shell Centre for Mathematical Education at Nottingham University, and the ITMA Project at Plymouth.

Expertise and equipment is spreading quickly beyond the inner circle of committed enthusiasts. Now computer users can hope to be guided safely past the blind alleys which have dogged early developments in this area.



EYES down! Mrs Thatcher studies some positive results of her micros for education scheme at South Downs College near Havant. The school has launched a four-year microelectronics programme supported by local industry and Hampshire County Council.

Help is at hand if you're stuck

Training courses are springing up everywhere, but many teachers have difficulty applying their new-found knowledge when they return to their own schools.

The ITMA Project (Investigations on Teaching with Micros as an Aid) and the Shell Centre for Mathematical Education are evaluating three types of training course. Each gives a pair of teachers a BBC micro, software, evaluation material and six workshop sessions. The difference is in the level of support given with the workshops. A school with full support has the benefit of a personal tutor with each session. Medium back-up means that the two teachers pack up their computer and join others for a workshop with a tutor. Minimum support means no tutor is provided with the workshops. The results are not yet available, but we'll let you know.

Details of these courses are available from Mrs. Rosemary Fraser, ITMA Project, College of St Mark and St John, Plymouth PL6 8BH, or from Professor Hugh Burkhardt, Shell Centre for Mathematical Education at Nottingham University.

A user group for teachers – and parents – is MAPE (Micros and Primary Ecducation), which was formally launched in January. Call for help to: Barry Holmes, St Helens Primary School, Bluntisham, Cambridgeshire (sae appreciated).



Solve the cyphers in Simon Dally's brainteaser and you are well on the way to winning this month's £20 prize of software.

CODE-BREAKERS

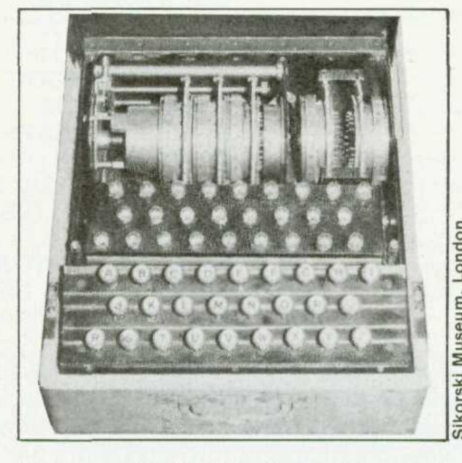
The advent of the computer age has opened up vast new areas in the field of codes and ciphers. A computer's ability to perform millions of operations slavishly and correctly makes it an ideal tool for taking the drudgery out of encoding and decoding a language. Indeed, looked at one way, a computer is a natural cryptological machine.

Some codes, such as semaphore or morse, have been developed, not to ensure secrecy, but to facilitate communications. Radio hams sometimes convert text to and from morse code with computers: if you can interface your micro to a short-wave radio you can have some fun 'eavesdropping' on the traffic.

The most famous example of a computer-related code must be that produced by the Enigma machine, used by the German High Command throughout World War II.

But at Bletchley Park in Buckinghamshire a top-secret Allied team was merrily reading most of the messages from mid-1940 onwards. The resulting material – dubbed 'Ultra' – is now recognised as having played a significant role in winning the war.

Enigma consisted of interlinking and individually settable wheels (three to begin with), each of which had 26 pairs of input/output leads, wired differently for wheel one, wheel two, etc. The operator would punch the relevant letter on a 26-letter keyboard and, via a tortuous route, the signal would travel through the wheels (and a few other things built into this electronic maze) before coming back to light up a different letter on a glass-covered keyboard. In this way a whole message could be encoded and sent by morse to its destination, where an identical machine would decode it.



Enigma with the lid off . . . this Polish reconstruction shows the wheels which did most of the encoding, the lamps which lit up the encoded or decoded letter and the keyboard.

If you are a skilful programmer, you could probably turn your micro into a simulation of an Enigma machine. On a BBC micro, the DEF PROC statement might be useful in setting up the input/output leads on each rotor.* For those less inclined to embark on grandiose projects, this month's competition features two secret messages. Both can be solved with pen and paper – but a computer program should make it easier.

In the example on the left below, each letter stands for one and only one other letter. The starting point is to analyse the frequency of the letters. The subject matter of the message, incidentally, was frequently helpful in breaking into Enigma.

The example on the right below is more complex, as it uses a keyword. Thus, if your keyword is 'ACORN' and the word you're encoding is 'Microcomputer', the result is NLRJCDRBHIUHG, obtained as follows: A is the first letter of the alphabet; you therefore add one to M to get N. C is the third letter, so I becomes L. O is the 28th letter, etc.

You have two clues from your spies: at least four of the five-letter words are suspected to be the same. Second, the encipherer is known to favour keywords of a literary bent –

'LEOTOLSTOY',

'WILLIAMSHAKESPEARE'.

One final aid – the spaces in both messages are genuine.

Send your entries to the Competition Editor by October 1 and mark them 'Competition 2'. The first three correct entries out of the bag win £20-worth of Acornsoft packages.

FOOTNOTE

*For details see *Top Secret Ultra* by Peter Calvocoressi (Sphere), *Ultra Goes to War* by Ronald Lewin (Arrow) and, best of all, *Cryptologia* vol 6, no 2 (Rose-Hulman Institute of Technology, Terre Haute, Indiana 47803, USA)

UVQOAVI IVGRIO XIRH OAV OJHVK NFDP XRFIOVVM MJMVOVVM
VJTAOP OUR DRMSRM KRFOA VQKO VMTDQMS OAFMSVIP KARUVIK
ZVCRHJMT HRIV UJSVKGIJEV UJMS VQKOVIDP DJTAO OR HRSVIQOV
HQYJHFH OVHGVIQOFIV OUVMOP X JEV SVTIVVK CVMOJTIQSV
KVEVMOP KVEVM XQAIVMAVJO

GISS J RTM F QRJZI J NIUPS KT O HIDEX N IXESWTOHII OC
B QMJGW C YVYVUMU VL U HVSMR GVO PBJB S CSHBHX U ROX
J DZU VPUD QRJZIJNA N MWXHG KPM GIB KO TSJ UCKIZUR B
UQBNL XFFUMM



Calling all Atom fans

The **Atom User Group** started in 1980 as a result of discussions between myself, then an undergraduate at Cambridge and the staff of Acorn. It is run as a part-time enterprise by three people in Coventry. We intend to provide a newsletter four times a year, and to provide a software library service, all at basically the cost of organisation, production and distribution.

Software in the library has been contributed by members of the group, and all members are encouraged to contribute software and articles for the newsletter.

Membership is around 1000 worldwide. The majority of members are individuals, although there are a number of schools. I feel the education section is an area that needs encouraging as it does not seem to be well supported.

If you would like any more information, contact: David Frost, c/o 18 Freshwell Drive, Potters Green, Coventry.

Teachers unite

Muse is a national organisation of teachers involved in schools microcomputing. Members receive our journal *Computers in Schools* four times a year, and two special reports on important and topical aspects of microcomputers. The February 1983 report will consist of a comprehensive review of the BBC micro and peripherals. The next report (September 1982) will deal with interfacing microcomputers.

Regular meetings are arranged and Muse is active in the development and standardisation of educational software. It supports an extensive library of progams for microcomputers. Other services to members include microcomputer (and video) insurance, and concessions with equipment suppliers.

Membership fee is £10 and forms can be obtained from Muse, Freepost, Bromsgrove, Worcestershire B61 7BR.

And the rest

■The **BBC (National) User Group** holds monthly meetings: has a free software library, and issues a monthly news-sheet: Discounts arranged on printers, disk drives, and other hardware. Membership £8 a year payable to the Group. Contact: J. Craig, 40 Mount Pleasant Avenue, Wells, Somerset BA5 2JQ

■Abug stands for Atom/BBC User Group. Meetings are on second Wednesday of every month at premises of Superior Systems Ltd, 178 West Street, Sheffield from 6.30-8.30 pm. Contact Steve White at (0742) 755005

■Beebug have asked us to inform readers that the club is run by Sheridan Williams and David Graham.

Anybody else out there? Contact Acorn User, 53 Bedford Square, London WC1

USER GROUP LIST

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Crescent Road
Manchester 8

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Mr B. Carroll
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GU11 3DG

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N-7000 Trondheim
Norway

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Oxford OX1 3JP

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Bedfordshire

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N.P. (Bazyle) Butcher
Harrow Computer Group
16 St Peter's Close
Bushey Heath
Watford WD2 3LG

Richard Green
Muse
22 Tennyson Avenue
Hull HU5 3TW



THE BEST FIT

Paul Beverley on straight-line graphs

This program aims to provide a means of displaying experimental data graphically. The data represented on the graph can be inspected and then, if appropriate, it can be approximated to a straight line, the gradient and intercept being calculated by the method of

continued page 63▶

```
   10 FDIM%XX50,%YY50;DIM C20,B5,P-1
   20 P.$21;V=P;[JSR#FFE3;RTS;]
   30 H=185;W=249;J=4
   40nN=0;P=0;L=0;%A=0,@=1
   50 P.$6$12"INPUT YOUR VALUES AS PROMPTED"'';G.x
  100mP.$12"1. INPUT MORE POINTS"'
  110 P."2. CHECK VALUES ALREADY ENTERED"'
  120 P."3. CHANGE CERTAIN VALUES"'
  130 P."4. PLOT POINTS ONLY"'
  140 P."5. CALC. GRADIENT & INTERCEPT"'
  150 P."6. CALC. GRADIENT FOR Y=MX"'
  160 P."7. PLOT PTS. & BEST FIT LINE"'
  170 P."8. DELETE CERTAIN POINTS"'
  180 P."9. SET SIZE OF DIVISION MARKS"'
  190 P."10. RESTART"'
  200 IN.$B;D=%VAL$B;IF D<1 OR D>10 G.m
  210 G.(1000*D)
 1000 P.$12
 1010xN=N+1
 1020zP."X"N;IN.$B;%XXN=VAL$B
 1030 IF?B=13 N=N-1;G.m
 1040 GOS.c;IF E G.z
 1050yP."Y"N;IN.$B;%YYN=VAL$B
 1060 IF?B=13 N=N-1;G.m
 1070 GOS.c;IF E G.y
 1080 G.x
 1100cE=0;FORD=0TO(LENB-1)
 1110 T=B?D;IF T<58 IFT>47 N.;R.
 1120 IF T=69 ORT=46 ORT=45 ORT=43 ORT=13 N.;R.
 1130 E=1;P.$7;N.;R.
 2000 P.$12"PRESS RETURN TO GO ON"''
 2010fFOR A=1TON;P.A"  ";FP.%XXA"  "%YYA'
 2020 IF A%16=0 LINKV
 2030 N.;IF L=2 L=0;G.p
 2040 IF L L=0;G.h
 2050 G.v
 3000 GOS.w
 3010 IN."CHANGE"$B;IF?B=78 L=1;G.f
 3020 IF?B>48 IF?B<58 G.u
 3030hIN.'"CHANGE POINT NUMBER"$B
 3040uA=%VAL$B;IF A>N P.'"I ONLY HAVE  "N"PAIRS!"';G.h
 3050 FP.'"I HAVE  "%XXA"  "%YYA''
 3060 P."WHAT SHOULD THEY BE?"'
 3070 P."X"A;IN.$B;IF LENB THEN %XXA=VAL$B
 3080 P."Y"A;IN.$B;IF LENB THEN %YYA=VAL$B
 3090kIN."ANY MORE"$B;IF ?B=78G.m
 3100 IF?B>48 IF?B<58 G.u
 3110 IF?B=89 G.h
 3120 G.m
 4000 P.$12
 4010i%L=%XX1;%M=%YY1;%P=%L;%Q=%M
 4020 FOR A=2TON
 4030 FIF %XXA>%L THEN %L=%XXA
 4040 FIF %XXA<%P THEN %P=%XXA
 4050 FIF %YYA>%M THEN %M=%YYA
 4060 FIF %YYA<%Q THEN %Q=%YYA
 4070 N.;IF L=2 L=0;G.9010
 4080 FIF %P>0 THEN %P=0
 4090 FIF %Q>0 THEN %Q=0
 4100 %F=W/(%L-%P);%G=H/(%M-%Q)
 4110 F=3-%(%P*%F);IF F<3 F=3
 4120 G=3-%(%Q*%G);IF G<3 G=3
 4130 CLEARJ;MOVE F,0;DRAW F,191;MOVE0,G;DRAW 255,G
 4140 FOR A=1TON;PLOT14,(%(%XXA*%F)+F),(%(%YYA*%G)+G)
 4150 PLOT8,2,2;PLOT1,0,-4;PLOT1,-4,0;PLOT1,0,4;PLOT1,4,0
 4160 N.;FIF %A=0 G.a
 4170 D=1;GOS.b;GOS.d;D=-1;GOS.b;GOS.d
 4200aIF L L=0;G.e
 4210 G.v
 4300b;%N=0;DO %N=%N+D*%A;%R=%N*%F+F;MOVE%R,(G-2);PLOT2,0,4
 4310 U.%R>255 OR %R<0;R.
 4400d%N=0;DO %N=%N+D*%B;%R=%N*%G+G;MOVE(F-2),%R;PLOT2,4,0
 4410 U.%R>191 OR %R<0;R.
 5000 P.$12;GOS.j;IF E E=0;L=0;G.v
 5010 %P=0;%Q=0;%S=0;%D=0;%U=0
 5020 FOR A=1TON;%P=%P+%XXA;%Q=%Q+%YYA;N.
 5030 %P=%P/N;%Q=%Q/N
 5040 FOR A=1TON;%X=%XXA-%P;%S=%S+%X*%YYA;%D=%D+%X*%X;N.
 5050 %S=%S/%D;%C=%Q-%S*%P
 5060 FOR A=1TON;%T=%YYA-%S*%XXA-%C;%U=%U+%T*%T;N.
 5070 %U=%U/(N-2);%V=SQR(%U/%D)
 5080 %W=SQR(%U*(1/N+%P*%P/%D))
 5085 IF L G.i
 5090 FP."GRADIENT= "%S'"ST.DEV.= "%V''
 5100 FP."INTERCEPT= "%C'"ST.DEV.= "'%W;G.v
 6000 P.$12;GOS.j;IF E E=0;L=0;G.v
 6010g%S=0;%U=0;%D=0;%C=0
 6020 FOR A=1TON;%S=%S+%XXA*%YYA;%D=%D+%XXA*%XXA;N.
 6030 %S=%S/%D;FORA=1TON;%T=%YYA-%S*%XXA;%U=%U+%T*%T;N.
 6040 %U=SQR(%U/(N-1)/%D)
 6050 IF L G.i
 6060 FP."GRADIENT= "%S''"ST.DEV.= "'%U;G.v
 7000 P.$12;L=1
 7010 IN."DO YOU WANT TO ASSUME Y=MX"$B;IF?B=89 G.g
 7020 G.5000
 7100e%X=%P*%F-4;%Y=(%S*%X/%F+%C)*%G;MOVE (%X+F),(%Y+G)
 7110 %X=%L*%F+4;%Y=(%S*%X/%F+%C)*%G;PLOT5,(%X+F),(%Y+G)
 7120 G.v
 8000 GOS.w;IN."DELETE"$B;IF?B=78 L=2;G.f
 8010 IF?B<>13 IF?B<>89 G.8000
 8020pM=0;DO
 8030 IN.'"DELETE POINT NUMBER"$B
 8040 C?M=%VAL$B;M=M+1;U.LENB=0;M=M-1;IF M=0 G.m
 8050 FOR T=0TOM;A=0;FOR D=0TO M;IF C?D>A A=C?D;K=D
 8060 N.;C?K=0;IFA=0 N.;G.m
 8070 N=N-1;FOR D=A TO N;%XXD=%XX(D+1);%YYD=%YY(D+1);N.;N.;G.m
 8200wP.$12"THE POINTS YOU HAVE ENTERED"'"ARE NUMBERED 1 TO "N
 8210 P.''"DO YOU KNOW THE NUMBERS OF THE"'
 8220 P."POINTS YOU WANT TO ";R.
 9000 P.$12;L=2;G.i
 9010 FP."THE RANGE OF X VALUES IS"'%P"  TO  "%L''
 9020 FP."THE RANGE OF Y VALUES IS"'%Q"  TO  "%M''
 9030 FIF %A=0 G.s
 9040 P."THE X";GOS.r;FP."  "%A'';P."THE Y";GOS.r;FP."  "%B'
 9050sGOS.q;IN." X AXIS"$B;GOS.c;IF E G.s
 9060 IF?B=13 G.t
 9070 %A=VAL$B
 9080tGOS.q;IN." Y AXIS"$B;GOS.c;IF E G.t
 9090 IF?B=13 G.m
 9100 %B=VAL$B;G.m
 9200qP.'"WHAT SIZE OF DIVISIONS DO YOU"'
 9210 P."WANT TO USE FOR THE";R.
 9300rP." AXIS IS NOW MARKED IN"'"DIVISIONS OF ";R.
 9400vLINKV;G.m
 9500jIF N>2 R.
 9510 P.$7"LEAST SQUARES METHOD WILL NOT"'
 9520 P."WORK WITH LESS THAN 3 POINTS."'
 9530 E=1;R.
10000 G.n
```



Your Letters

I would like to ask some questions about my BBC micro, Model B.

There is an annoying buzz from the speaker, which goes off only when the break key is pressed. What can I do about this?

Are all expansion sockets supplied on the Model B?

In the diagram on page 13 of the first issue of Acorn User 5 ROM ICs are shown but in my Model B there are no ICs in sockets 88, 100, and 101. What effect will this have?

Can you tell me the approximate cost of the BBC disc system with single side disc drive including any work which has to be done by an Acorn dealer? The Atom disc pack includes regulated power supply. Does the BBC disc pack also include this?

G. Tromans
Halesowen

The buzz from the speaker is more pronounced on some machines than on others. It can be stopped most simply by fitting a plug into the 1MHz expansion bus and on this plug fitting a resistor between pin 16 and pin 15. The resistor should have a value of 10k ohms. Alternatively a similar resistor can be soldered to the printed circuit board between the appropriate tracks. The modification to reduce the level of this buzz is being included in the next issue of the printed circuit boards.

The Econet expansion as well as the disc internal expansion and the speech synthesis internal expansion are all additional rather than being fitted as standard on the Model B.

Some machines have been supplied with the operating system in EPROM in the sockets that you mentioned. In other machines four EPROMs are replaced by a single ROM. This does not affect the performance of the machine in any way.

The BBC disc system does not have a regulated power supply. The switch mode power supply on the BBC microcomputer is able to run the discs as well as the computer itself. If such a power supply was not fitted initially then the dealer will fit this as part of the disc upgrade. If you wish to have your model B subsequently upgraded to include a disc interface then the dealer will do this and will probably charge in the region of £80 or £90. The single disc drive itself costs £265.00.



We have received our ten BBC microcomputers and are very pleased with them. The odd fault here and there but nothing at all to worry about. We have, or rather will have, very soon, ten colour monitors to go with them; they are all cassette based at the moment 5 x A's and 5 x B's. I have just ordered another 6 x B's. I am not convinced that I want an Econet; I may rather like more stand alone disc systems. So where do you suggest we go from here?

D.W.J. Carne
Exeter School

Here are a few comments that may help you to plan for the future. It is quite possible to put a large number of disc systems on the network and as there are very clear advantages in a network system we would encourage you in that direction. For example with a network all the users can share one or more expensive printers. A network would enable the teacher to see what each person is doing without having to actually walk around and can also be used over a considerable distance as a message service.

However, if you do find that you can afford a large number of disc systems then there is absolutely nothing to stop you installing those alongside the net. Any one or more other disc systems can act as a file server or of course they can be used individually.

My BBC Model B has exceeded all my expectations except in one – alas vital – respect.

Readback from cassette of both 'SAVEd' and 'PRINT#' information is so unreliable that over 75% of my programming effort is being wasted trying to deal with this difficulty.

I have tried every expedient I can think of, including 4 different cassette units, different computer tapes, variations in volume and tone control, and in recording speeds etc. etc. – only the latter seems to have any effect upon the failure rate – which averages 66%.

The prospect of being unable to read-back masses of laboriously keyed-in program and data turns programming from a stimulating challenge to a nightmare. The only answer seems to be to keep dozens of copy and archive back-up tapes in the hope that just one of them will read back.

I understand that many other users are suffering from the same frustrating experience.

Quite apart from the failure rate, the messages 'Data?' 'Block?' 'File?' are pointless unless they also help the user by informing him of exactly what has gone wrong, exactly why and exactly how it can be put right. If volume levels are incorrectly set, for example, the message should read, 'turn up volume' or 'turn down volume'. In the contemporary computer jargon the error messages from tape failure are 'user unfriendly'.

Moreover it is intolerable that an entire cassette file should be jettisoned as useless due to a failure at just one point. It should at least be possible to read in the good blocks, if necessary re-keying the lost sections.

Ronald Alpiar
Wimborne

We are sorry to hear of the trouble you have been having over readback from your cassette. We have passed your complaints on to Acorn Computers who have suggested that their <u>cassette filing system</u> program may be of help to you.

After having acquired the first issue of 'Acorn User', I wondered if perhaps the Atom was made by Acorn Computers. Has the Atom become the BBC computer's poor relation? I am sure there must be others like myself out there in computerland grovelling for software for the Atom.

If, as you state, you are the 'Acorn Users official magazine' how about some user defined graphic details, modes minus snow etc. and perhaps a few programming hints and tips to enable us mere Atomisers to tickle the keyboards.

Does the Atom BBC ROM mean I can load BBC software tapes?

W. Hoy
Edinburgh

We must apologize to all the Atom users who felt that we gave too much space to the BBC micro in the first issue. We have included several items specifically for Atom users in this issue and plan to continue to do so. On page 38 we publish details of the BBC BASIC Board for the Atom. This will enable Atom owners to run most software for the BBC micro on their Atoms. However, programs must be typed in, they cannot be run from cassette. See page 38.

CASSETTE FILING SYSTEM

A number of shortcomings in the machine operating system version 0.1 for the BBC micro have come to light. This article provides details of two useful modifications that can be applied by users to their own machines.

Perhaps the two most significant problems with the machine operating system are concerned with the cassette filing system. The first involves the character output routines within the operating system whereby complete Basic strings are sometimes not written to the tape. The second is caused by a hardware problem which corrupts certain files as they are written to the tape. This prevents the file being input back into the computer.

A software modification to remedy these problems has been devised by Richard Russell of the BBC and has been evaluated by Acorn. So far as it is possible to ascertain, the prescribed change overcomes these difficulties.

For the technically minded, detailed descriptions of the problems are given here. In the first case, the cassette OSBPUT routine sometimes alters the processor's A register when this should be preserved. If this occurs when Basic is outputting a string in a PRINT# statement, the characters of the string will not be sent to the tape. This will then be detected during use of a subsequent INPUT# statement at which point a type mismatch error will occur.

The second problem is caused by the corruption of the first byte of a block on tape. Since this contains block header information, the block itself cannot be read back. One particular manifestation of this is that a program SAVEd at 1200 bits per second may not subsequently be LOADable.

The modification is given below as a program to be typed into the BBC micro and RUN on startup. It contains a *KEY command in line 9 to ensure the modification is preserved over use of the BREAK key. Obviously, the modification is lost from memory if power is turned off and also on a 'hard reset' (rapid BREAK BREAK). Having installed the modification it might be a good plan to SAVE it on the front of a tape to be LOADed whenever the computer is started up.

```
1REM OS 0.1 CFS PATCH
2REM <FIX1> restores register A
3REM over a PUTBYTE call.
4REM
5REM <FIX2> avoids tape corruption
6REM during SAVE and PUTBYTE
7REM
8REM Machine code is located at &DD0
9 *KEY 10 ?&218=&D0:?&219=&D:
   ?&20A=&D6:?&20B=&D|M
10FORI%=0TO1:P%=&DD0:GOSUB50:NEXT
20?&218=FIX1:?&219=FIX1 DIV 256
30?&20A=FIX2:?&20B=FIX2 DIV 256
40END
50[ OPT I%*2
60.FIX1 PHA:JSR &F521:PLA:RTS
70.FIX2 CMP#&91:BNE GO:CPX#0:BNE GO
80TSX:LDA&102,X:CMP#&F7:BEQ TRAP
90LDX#0:.TX LDA#&91:STA&FE09:RTS
100.GO JMP(&DB60)
110.TRAP PLA:PLA
120JSR&F9D8:JSR&FB7B
130JSR TX:JMP&F7FB
140]RETURN
```



Can you help me with the following please? Is the information on the teletext pages in machine code? How do I get the programs into my BBC micro? Would it be possible to take information direct from the screen using a television with a teletext display?

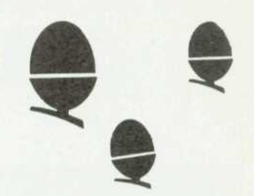
D. Coulter
Preston

The information that is transmitted on the teletext pages is in fact in Basic and not in machine code but a number of special symbols are used to mark particular characters such as the end of line character. It is not possible to type into the computer what you see on the screen. The special codes have to be de-coded by the BBC teletext unit which works with the BBC Microcomputer System. It is not possible to use a normal teletext television in any way at all to get teletext into the BBC Computer System. The only way that one can receive telesoftware directly to the BBC Microcomputer is with the special unit mentioned above.

Whether you would like to have a question answered or just to air your views, write to us at *Acorn User,* 53 Bedford Square, London WC1B 3DZ. The Editor reserves the right to amend or alter any letter prior to publication.

Official Acorn Dealers in the U.K.

Acorn dealers stock and service the Atom computer, Acorn systems and Acorn softsoftware. Many also offer service facilities for the BBC micro and these are marked with an asterisk. The Acorn dealer not only sells computers and peripherals but provides vital customer support. Most have recently attended technical seminars in Cambridge to ensure that they deal effectively with customers' enquiries. In addition, Acorn supply dealers with specific test and diagnostic equipment to speed fault finding.



LONDON
Cavendish Sales E1
01-247 3453
Canonbury Radio N1
01-226 9392
*Centre of Sound W11
01-727 0511
*Group 70 E18
01-505 7724
*Micro Store SW3
01-352 9291
*Off Records SW11
01-223 7730
Paul Electrical SW20
01-542 6546
PAJ Rental Ltd NW4
01-368 0572
REW West End Video Centre WC2
01-240 3386/7
RA Bailey Ltd SE26
01-693 1818
*Technomatic Ltd NW10
01-723 0233
The Video Palace W8
01-937 8587

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Quality Radio & Television Co B14
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Typewriter Centre (Erdington) B23
021-382 0185
Typewriter Centre (Head Office) B5
021-622 5385/7
Typewriter Centre (Dudley Road) B18
021-455 9111
Typewriter Centre (Kings Heath) B14
021-444 7349

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*Microstyle Bath
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Cambridge
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0209 712681
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0208 3171

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▶continued from page 59

THE BEST FIT

Paul Beverley on straight-line graphs

least squares.* There are two main advantages of using the Atom instead of a programmable calculator. First, the scatter of points either side of the best straight line can clearly be seen, so any general trends can be noted and individual points, which may be suspect, can quickly be identified. Second, data can easily be added, deleted, or amended, and the effect on the best straight line can then be seen and/or calculated. (The graph is automatically re-ranged every time the data is changed, so that it fits exactly onto the screen.)

The structure of the program is such that after entering an initial set of pairs of X and Y values, the user is given menu:

- input more points
- check values already entered.
- change certain values.
- plot points only.
- calculate gradient and intercept.
- calculate gradient for Y=MX.
- plot points and draw best fit line.
- delete certain points.
- set size of division marks for axes.
- restart.

The program should be entirely self-documenting, and no problems encountered during running, provided you follow the general rule: *If in doubt – press the return key.* If you are being asked to input, delete or change anything, and you don't want to, just press return.

The program was written to run in a fully-expanded Atom (12k+12k) but if you only have 3k in the graphics memory, you could change line 30 to H=185; W=121; J=3 (or even with 1½k – H=90; W=121; J=3).

A bare listing of the program is provided, but for a fully annotated listing plus a cassette of the program send £1.50. to Mr P. Beverley, Department of Electronics & Electrical Engineering, Norwich City College, Ipswich Road, Norwich, to whom comments and criticisms should be sent – they would be much appreciated.

**Practical Physics* by G.L. Squires, McGraw-Hill, ISBN 070940703.

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